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**NEPONSET RIVER FLOOD CONTROL
OPERATION AND MAINTENANCE
MANUAL**

**FOR
FLOOD PROTECTION WORKS
CANTON, MASSACHUSETTS
NEPONSET RIVER**



**U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.**

OCTOBER 1963

NEPONSET RIVER FLOOD CONTROL
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EAST BRANCH NEPONSET RIVER
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FOREWARD

The successful functioning of flood protective works is not assured solely by construction of a system of adequate dikes, diversion channel and other appurtenant structures. If the system is to perform the functions for which it was designed, it must be carefully maintained during periods of normal river stages and properly operated during flood periods.

The need for proper maintenance cannot be too highly stressed in view of the fact that large damages may be incurred through failure of a critical element in flood time, caused by deterioration or damage that would have been eliminated by proper maintenance.

Necessary maintenance and proper operation require that responsible local persons have a thorough understanding of the functions of the various units of the system, and the best methods of maintaining the system and operating it during flood emergencies. It is the purpose of this manual to provide complete information so that all parties may know their responsibilities in maintaining and operating the flood protection system in accordance with the regulations of the Secretary of the Army as amplified by this manual.

The Flood Control Regulations for Maintenance and Operation of Flood Control Works quoted herein were approved by the Acting Secretary of War on 9 August 1944. Upon establishment of the Department of Defense the improvement of rivers and harbors and other waterways for flood control and other purposes, formerly under the jurisdiction of the Secretary of War, became the responsibility of the Secretary of the Army. Reference therein to the Secretary of War and War Department shall be construed to mean, respectively, the Secretary of the Army and Department of the Army. Where reference is made to the District Engineer in the regulations included in this manual, it shall be construed to mean the Division Engineer, U. S. Army Engineer Division, New England, Waltham, Massachusetts.

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SECTION I

INTRODUCTION

1. AUTHORIZATION

Construction of a local protection project on the Neponset River at Canton, Massachusetts was authorized by the Chief of Engineers on 19 July 1961 pursuant to authority contained in Section 205 of the 1948 Flood Control Act, amended by Section 212 of the 1950 Flood Control Act and further amended by Public Law 685, 84th Congress, 2nd Session, approved 11 July 1956.

2. LOCATION

The project is located in the southern part of the "Greater Boston Region" of Massachusetts in Norfolk County along the East Branch of the Neponset River. The East Branch of the Neponset River rises at Forge Pond in the center of Canton. The river pursues an erratic northwesterly course for about 2.2 miles, entering the Neponset River at the Norwood-Canton townline. The project is located about two miles upstream of the confluence of the Neponset River.

3. DESCRIPTION OF PROJECT

The project provides for the diversion of flood flows from the East Branch Neponset River around the Plymouth Rubber Company Plant, and consists of the following: a concrete overflow dam 160 feet long located adjacent to the existing Plymouth Rubber Company dam; a diversion channel below the dam about 1600 feet long with a rock-faced dike on the right bank; rock-faced fill on the left bank of the channel; and a small intake structure that controls the flow at the mouth of the canal, diverting processing water to the Plymouth Rubber Company. The structure contains a manually-operated gate for a 24-inch cast iron pipe intake and has a small trash rack to catch debris. Drainage outlets and access ramps are also incorporated in the project. A U.S.G.S. gauge which is located immediately downstream of Washington Street records flows of the East Branch.

4. PROTECTION PROVIDED

The project will generally provide protection for the Plymouth Rubber Company, located along both banks of the East Branch Neponset River, representing the largest single industry in the town, and several other upstream commercial establishments located along Washington Street. The construction of the diversion channel will

provide protection for flood flows up to 3000 c.f.s. which is 77 percent greater than the flood of record of 1700 c.f.s., which was experienced in August 1955. The new channel would divert 2100 c.f.s. while the remaining 900 c.f.s. would continue to flow in the present channel.

5. CONSTRUCTION HISTORY

Construction of the project was initiated on 5 June 1962 and was completed in July 1963. The project was constructed by the Gil-Bern Construction Corporation of Canton, Massachusetts. Approximate quantities of materials and items used are as follows:

Excavation	28,500	C.Y.
Rock Excavation	5,200	C.Y.
Compacted Fill	11,200	C.Y.
Stone Slope Protection	7,000	C.Y.
Gravel	400	C.Y.
Concrete	670	C.Y.
Intake Structure	1	Each
Metal Bins	6	Each
Miscellaneous Materials		

6. PLANS

Full-sized tracings of "as-built" construction drawings have been provided the Town of Canton, Massachusetts. A reduced size set of "as-built" drawings showing the project as actually constructed is inclosed in Appendix E.

SECTION II

LOCAL COOPERATION REQUIREMENTS

7. FLOOD CONTROL ACTS

Section 3 of the Flood Control Act approved 22 June 1936 (Public Law No. 738, 74th Congress) provides "That hereafter no money appropriated under authority of this Act shall be expended on the construction of any project until States, political subdivision thereof, or other responsible local agencies have given assurances satisfactory to the Secretary of War that they will:

"(a) Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project;

(b) Hold and save the United States free from damages due to the construction works;

(c) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of War."

Section 212 of the Flood Control Act of 1950, pursuant to the provisions of which section construction of the Canton Local Protection Project on the East Branch Neponset River was authorized by the Chief of Engineers, states that "The provision of local cooperation specified in Section 3 of the Flood Control Act of 22 June 1936, as amended, shall apply."

Public Law 685 amended Section 212 of the Flood Control Act of 1950 to increase the statutory limitation to \$400,000. Assurances were also required that local interests agree to pay all construction costs in excess of \$400,000, if required, to provide a complete and effective project; and make cash contribution for project cost allocated to project features other than flood control.

8. ASSURANCES

The Town of Canton voted on 16 March 1959 to authorize the Board of Selectmen to enter into agreements and to provide assurances to the United States of America as required by law. Assurances were also received by the Commonwealth of Massachusetts to underwrite the requirement to contribute to the United States all construction funds found to be necessary over and above the Federal expenditure limitation of \$400,000. Copies of the formal assurances are included as Appendix B. Local interests have met all requirements except operation and maintenance of the project, which they agreed to do in accordance with this manual.

SECTION III

GENERAL REGULATIONS

9. PURPOSE OF THIS MANUAL

The purpose of this Manual is to present detailed information to be used as a guide in complying with "Flood Control Regulations - Maintenance and Operation of Flood Control Works" as approved by the Acting Secretary of War on 9 August 1944, and published in this volume as Appendix A. In executing assurances of local cooperation, the Town has agreed to maintain and operate the completed works in accordance with these regulations. The regulations which are intended to cover all local protection projects constructed by the Department throughout the United States, are general in nature, and obviously cannot give detailed instructions for the maintenance and operation of a specific project. The details set forth in this Manual for maintenance and operation of the Canton project are intended to supplement the regulations to permit obtaining all the benefits and protection against floods for which the project was designed. Failure to maintain and operate the project as required by the regulations and as detailed herein can cause severe property losses and loss of life and can result in an irreparable loss of confidence in the flood protection system by citizens who have invested their funds on the basis of the protection which it provides.

10. GENERAL RULES AND REGULATIONS

Paragraph 208.10(a) of the regulations prescribed by the Secretary of War gives general rules for the maintenance and operation of structures and facilities constructed by the United States for local flood protection. Applicable portions are quoted below to avoid the necessity for cross reference and are further defined by remarks under each quotation.

"(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits."

These requirements cannot be overstressed, and the Town authorities must make adequate provisions for funds, personnel, equipment and materials to allow for the proper maintenance and operation of the flood protective works.

"(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent", who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States."

The committee should be composed of competent members, preferably men experienced in engineering or construction work of a nature similar to the flood protection works. The committee must be given broad authority to carry out its responsibilities. The name, address, and office and home telephone numbers of the Superintendent, and any changes thereof, shall be promptly furnished the Division Engineer.

"(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times."

Three men should be available to meet any ordinary emergency that may occur during flood periods. Borrow pits for embankment gravel and rock materials should be secured and sources of additional supplies of materials, tools, and equipment should be well established in order that these articles can be obtained quickly in case of an emergency.

"(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities."

"(5) No improvement shall be passed over, under or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representatives that such improvement, excavation, construction or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed

improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer, or if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work."

"(6) It shall be the duty of the Superintendent to submit a semianual report to the District Engineer covering inspection, maintenance and operation of the protective works."

"(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works."

The Division Engineer or his representatives will make periodic inspections of the protective works to determine if the project is being properly maintained and operated by the Town.

"(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made."

The Town should maintain the facilities and keep them in good repair and not wait for the Division Engineer to call such matters to its attention. Upon request, the Division Office will advise the Town how to make any repairs to the facilities.

"(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods."

"(10) The Corps of Engineers will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

The flood control committee should familiarize itself with the contents of this manual. The Town authorities are encouraged to call on the Division Office of the Corps of Engineers for any additional advice or instructions required by them in carrying out the Town's obligations for maintaining and operating the flood protection facilities.

11. MAINTENANCE

a. The word "maintenance" as used in this manual applies to the upkeep, repair and care of the work constructed by the United States and turned over to the Town of Canton. If the work is neglected there will be deterioration and possible failure in flood time when there is dire need of dependable protection.

b. Satisfactory and dependable operation depends on constant maintenance. The organization that performs maintenance will be familiar with various parts of the system and will be in a position to use them effectively in time of stress.

c. Maintenance includes regular inspection of the entire system. The purpose of an inspection is to detect any deterioration or faulty operation that indicates a need for repair or replacement.

d. Each of the major features of the project will be discussed separately with respect to the points which, based on experience with special project features, require special attention.

12. OPERATION

Operation in this manual refers to the actual use of the various features of the protection works during flood periods. It is intended that the procedure outlined herein will be sufficient to insure protection from floods to the designed flood stage. However, advice relative to operation may be obtained at any time from the Engineering Division of the New England Division Office.

13. REPORTS

a. The regulations prescribed by the Secretary of War call for semiannual reports to be submitted by the Superintendent to the Division Engineer, covering inspection, maintenance and operation. Inspection of the flood protective facilities shall be made immediately prior to flood seasons, immediately following floods and otherwise at intervals not exceeding 90 days as required by the regulations.

b. To assist the Superintendent in making his inspections and reports, sample forms have been prepared and are included in Appendix C. The Superintendent shall have additional copies printed for use in submitting his reports.

c. The semiannual reports should be submitted in triplicate to the Division Engineer each February and August. The reports will be submitted in letter form with copies of the inspection forms covering the inspections made during the period of the report. The reports shall cover the following points:

(1) A description of the maintenance work performed in the preceding six months.

(2) The number and classification of men working on maintenance regularly and intermittently.

(3) Description of any work performed by contract on the repair or improvement of the project.

(4) Description of use or operation of the system during the period being reported.

(5) Suggestions relative to public cooperation and comments concerning public sentiment on the protection obtained are considered pertinent and desirable data for inclusion in the report, but such data are not required.

SECTION IV

DIVERSION CHANNEL

14. DESCRIPTION

Plate No. 2 shows a general layout of the local flood protection project which provides for the diversion of flood flows around the Plymouth Rubber Company plant. It includes a concrete overflow dam about 160 feet long, located adjacent to an existing dam owned by the Plymouth Rubber Company, and a diversion channel below the dam about 1600 feet long with a bottom width of 60 feet. The left bank along the channel and the right bank, which incorporates a dike varying in height from 0-7½ feet, are constructed of compacted fill. The banks of the channel have side slopes of 1 vertical on 2 horizontal with 2 feet of rock slope protection obtained from channel excavations.

15. MAINTENANCE

Paragraph 208.10(g)(1) of the prescribed regulations set forth rules for the maintenance of channels and floodways. These rules are quoted below.

"Channels and floodways. - (1) Maintenance - Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

"(i) The channel or floodway is clear of debris, weeds, and wild growth."

All debris and growth which tend to restrict the channel shall be promptly removed.

"(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments."

Dumping of waste materials or any types of encroachment on the channel shall be prohibited and prompt steps shall be taken to remove or have removed any such encroachments.

"(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals."

Shoal areas should be removed but care should be exercised that slopes of the channel and existing banks are not undercut. Existence of shoal areas will be apparent from inspections.

"(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of bank has occurred."

"(v) Riprap sections and deflection dikes and walls are in good condition."

Rockfill slope protection must be maintained in good condition to resist erosion. Any loss of rock due to slides, erosion or vandalism must be promptly replaced. Periodic checks should be made of the stone slope protection, movement or loss of stone, and prompt corrective action taken.

"(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works."

"Such inspection shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary."

16. OPERATION

Paragraph 208.10(g)(2) of the prescribed regulations gives rules for operation of channels and floodways. These rules which are quoted below are self-explanatory and require no amplification with regard to the Canton project.

"(2) Operation. - Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

17. EMERGENCY REPAIR MEASURES

Rules and instructions for emergency repair measures for the dikes as given in paragraph 21 are equally applicable to emergency repairs of the channel.

SECTION V

DIKES

18. DESCRIPTION

The dike constructed on the right bank of the diversion channel is composed of compacted fill with side slopes of 1 vertical on 2 horizontal, and 2 feet of rock slope protection on the channel side with grassed slopes on the back side. The dike which is 1500 feet in length, varies in height from 0 to 7-1/2 feet above the ground. A 10-foot wide roadway, surfaced with 6-inches of gravel, has been placed on top of the dike. A 24-inch diameter C.M. pipe drain with flap valve extends through the dike and is used to collect interior drainage.

19. MAINTENANCE

Paragraph 208.10(b)(1) of the prescribed regulations sets forth rules for the maintenance of levees. These rules apply equally to earth dikes, and applicable portions are quoted below.

"Levees. - (1) Maintenance. - The Superintendent shall provide at all times, such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, to exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out, and further, to be certain that:

"(i) No unusual settlement, sloughing or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might effect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) _____ Not applicable _____.

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) _____ Not applicable _____.

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during time of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days; and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent."

Any unusual settlement, sloughing or caving should be corrected to restore the original dike grades. No major repair work shall be made without prior approval of the Division Engineer in order that such repairs that may be necessary will not adversely affect the functioning of the protective facilities.

Inspections of the dike shall be made during and after periods of high water, as it is at such time that any weak spots will be discovered that might otherwise be overlooked.

20. OPERATION

a. Paragraph 208.10(b)(2) of the prescribed regulations sets forth rules for the operation of the levees. These rules apply equally to earth dikes and are quoted below.

"(2) Operation. - During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

- (i) There are no indications of slides or sloughs developing;
- (ii) Wave wash or scouring action is not occurring;
- (iii) No low reaches of levee exist which may be overtopped;
- (iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section."

Patrolling the dikes should start when water reaches a stage of 3 feet above the crest of the dam, and should continue until the flood has reached its peak and receded below the stage of 3 feet. Patrolmen should be thoroughly instructed as to their duties, what they are to watch for, and the exact limits of their beat.

21. EMERGENCY REPAIR MEASURES

a. Scours. - Careful watch should be maintained over stretches of the dike where scouring is likely to occur, particularly at curves in the alignment where the dike is subject to heavy currents. If any indication of scouring is observed, soundings should be taken to observe the amount and progress of the scour. Sandbagging or dumped rock will generally afford the most practicable means of combatting this condition. The open ends of sandbags so used must be sewed or tied after filling with earth.

b. Sand boils

(1) General. - A sand boil is the result of a transfer of pressure head and seepage from the river through a pervious stratum near or at the surface to the landside of the levee. This seepage

under pressure tends to push its way to the surface and actually floats the material through which it flows. No harmful effect results provided the weight of the relatively impervious soil layer overlying the pervious stratum, in which the flow under pressure is occurring, is sufficient to counterbalance this pressure. When the soil stratum overlying the pervious layer is insufficient to counterbalance the upward pressure or when no such stratum exists, boils break through the surface on the landside wherever these weaknesses are present. The sand boil may discharge relatively clear water or the discharge may contain quantities of sand and silt, depending upon the magnitude of the pressure and the size of the boil.

(2) Effects of Sand Boils. - Sand boils can produce three distinctly different effects on the levee, depending upon the condition of flow under the levee. These three effects are illustrated in Appendix D. In Figure 1, Plate No. 1, the seepage flow develops a definite pipe or tube under the levee. This breaks out at the landside toe in the form of one or more large sand boils. Unless checked, this flow causes a cavern to be developed under the levee, resulting in subsidence of the levee and subsequent overtopping. This case can be most easily recognized by slumping of the levee crown. Figure 2, Plate No. 1, illustrates the case where seepage flows under pressure under the levee without following a defined path, as was the case above. This flow results in one or more boils outcropping at or near the landside toe. The flow from these boils tends to undercut and ravel the slope, resulting in a sloughing of the slope. Evidence of this type of failure is found in undercutting and ravelling at the landside toe. Figure 3, Plate No. 1, shows a third type of effect of a sand boil. In this case, numerous small boils, many of which are scarcely noticeable, outcrop at or near the toe. While no boil may appear to be dangerous in itself, the consequence of the group of boils is to cause flotation of the soil, thereby reducing the shearing strength of the material at the toe, where maximum shearing stress occurs, to such an extent that failure of the slope through sliding results.

(3) General Instructions for Handling Sand Boils. - All sand boils shall be watched closely. All boils shall be marked conspicuously with flagging so that patrols can locate them without difficulty and observe changes in their condition. A sand boil which discharges clear water in a steady flow is usually not dangerous to the safety of the levee. The only action necessary in this case is to drain the excess water off to prevent it from standing near the levee. However, if the flow of water increases, and the sand boil begins to discharge material, corrective action shall be undertaken immediately.

(4) Method of Treatment

(a) The accepted method of treating sand boils is to construct a ring of sand bags around the boil, building up a head of water within the ring sufficient to prevent further movement of sand and silt. The accepted method of ringing a sand boil, shown on Plate No. II of Appendix D, is as follows:

1. The entire base of the sack ring is cleared of debris, in order to provide a watertight bond between the natural ground and the sack ring.

2. The sacks are then laid in a ring around the boil with joints staggered, and with loose earth between all sacks.

3. The ring is carried only to a height sufficient to prevent material from being discharged. The ring should not entirely stop the flow of water, because of the probability of the excessive local pressure head causing additional ruptures of impervious strata and boils nearby.

4. A "V" shaped drain constructed of two boards or a piece of sheet metal, is then placed near the top of the ring to carry off the water.

(b) Actual conditions at each sand boil will determine the exact dimensions of the ring. The diameter and height of the ring depend on the size of the boil, and the flow of water from it. In general, the following considerations should govern:

1. The base width should be no less than $1\frac{1}{2}$ times the contemplated height.

2. It is well to include weak ground near the boil within the ring, thereby preventing a break-through later.

3. The ring should be of sufficient size to permit sacking operations to keep ahead of the flow of water.

(c) Where many boils are found to exist in a given area, a ring levee of sandbags shall be constructed around the entire area and, if necessary, water pumped into the area to provide sufficient weight to counterbalance the upward pressure.

d. Sloughs. - During prolonged high water stages, seeping and sloughing conditions on the back slopes may occur. Such conditions should be observed closely as to progress of seepage up the back slope and the amount of material that is being carried by the water. If the seep velocity becomes great enough to cause, or probably cause, erosion or sloughing of the slope, a sandbag covering should be placed on the seeping area, beginning well out from the toe and progressing up the slope. The covering should extend several feet beyond the saturated area. If the material is obtainable, the affected area should be covered with brush, straw or similar permeable material to a depth of two to four inches before placing the sandbag cover. This will permit the seep water to get away while serving as a filter to prevent loss of earth from the dike. After the covering is placed, close observation should be maintained and additional layers of sandbags placed on the previous ones until the velocity of the seepage is reduced to a point at which the amount of material carried is negligible. Sacking sloughs are illustrated on Plate No. III of Appendix D.

e. Raising Existing Earth Dikes. - In an emergency, time and other conditions permitting, the grade of a dike can be safely raised three feet. The methods most commonly used for this purpose are outlined in the following paragraphs.

(1) Sandbag topping. - The sack ordinarily used for topping an earth dike is a grain or feed sack which holds 100 pounds. Smaller sacks may be used if feed sacks are not available. Grain sacks, filled with about one cubic foot of earth, weighing about 100 pounds, will provide a unit about six inches high, one foot wide and two feet in length.

The sacks may be filled at the source of material and hauled to the dike or filled from stockpile or borrow areas at the dike, conditions determining the method employed. The same is true of filling; i.e., whether power or hand methods are used. The open end of the sacks should always face upstream or toward the riverside of the dike and need not be sewed or tied. When the sack faces the river the loose end should be folded under and when facing upstream the loose end covered by the succeeding sack.

The front line of sandbags in the first layer should be laid parallel to the dike centerline and remaining bags at right angles to the centerline. The sandbags in the second layer are all laid at right angles to the centerline, the third row similar to the first, etc., as shown on Plate No. IV of Appendix D. All sacks should be lapped about 1/3 each way and well mauled or tramped into place. The sacks should be filled to 2/3 their capacity when flattened out to facilitate proper placing and prevent bursting the sack when mauled or tramped into place.

Plate No. IV illustrates the progressive method of increasing the dike height and gives an approximation of the number of sacks required for dikes of various heights. Plate No. V shows pictures of model sack dike or topping.

A crew of 50 men should fill, carry and place approximately 1500 sacks per eight-hour day, all hand labor, when the source of material is within 150 feet of the point of placement. Production will depend on conditions at the site.

(2) Lumber and sandbag topping. - This is the most satisfactory method of raising low reaches of earth dike in emergencies. The chief objection is the time required to install. In putting on this topping, as well as any other topping, a careful line of levels should be run and grade stakes set in advance unless the dike top follows a dependable grade-line. Two-by-four or two-by-six inch stakes should then be driven on the riverside of the crown six feet apart and one-by-twelve inch boards nailed to landside of the stakes. This wall, backed with a single tier of sandbags, will hold out at least one foot of water. If the second foot is necessary, the layers of bags will have to be increased in number and reinforced. Sandbags are laid substantially in the manner described in (1) above. The stakes should be driven at least three feet into the ground, leaving at least three feet out, which will, in extreme cases, hold a three-foot topping if properly braced behind with sandbags. Plate No. VI, Appendix D illustrates this method of raising a dike.

SECTION VI

DIVERSION DAM

22. DESCRIPTION

Plate No. 5 shows a general layout of the diversion dam, composed of a curved concrete ogee-shaped spillway section cut out of rock. On both abutments the 160 foot weir terminates against a short section of concrete gravity wall that rests on rock foundation. The crest of the weir is at elevation 80.3 m.s.l. which is 0.2 feet above the existing dam of the Plymouth Rubber Company. The small difference in crests will insure that low discharges will flow in the existing channel.

23. MAINTENANCE

Periodic inspection shall be made of this structure by the Superintendent and appropriate maintenance measures taken to insure that facilities which function as a part of it will operate properly. Regulations, modified as applicable to this structure, shall be followed to be certain that:

a. No unusual settlement, sliding, loss of grade, or dam cross-section has taken place;

b. Encroachment is not being made on the dam or its right-of-way, which might endanger the structure or hinder its proper functioning during times of emergency.

Such inspection shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days, and such intermediate times as may be necessary to insure the best possible care of the dikes and walls. Immediate steps shall be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

24. OPERATION

There are no operational requirements to be performed at the concrete dam. Patrol of the structure shall be made following a flood to locate possible leakage at monolith joints or seepage underneath the dam and walls. Floating plant or boats shall not be allowed to lie against or tie up to the dam. Immediate steps shall be taken to correct any condition which endangers the stability of the dam or its abutment walls.

SECTION VII

FLOOD WALLS

25. DESCRIPTION

A concrete gravity type wall was constructed from the existing Plymouth Rubber Company dam to the intake structure on the right bank of the East Branch Neponset River for a distance of 63 feet, and from the intake structure upstream for a distance of 23 feet to tie into the earth dike. There is also a stretch of gravity type wall at both ends of the concrete diversion weir. On the left bank the wall extends for a distance of 35 feet and on the right bank the wall extends for a distance of 60 feet. Details of the location and cross-sections of the walls are shown on the plans included as Appendix E.

26. MAINTENANCE

Paragraph 208.10(c)(1) of the prescribed regulations gives rules for the maintenance of flood walls. Applicable portions of these rules are quoted below.

"(c) Flood Walls. - (1) Maintenance - Periodic inspections shall be made by the Superintendent to be certain that:

- (i) No seepage, saturated areas, or sand boils are occurring;
- (ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;
- (iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;
- (iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might effect the stability of the wall or its water tightness;
- (v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;
- (vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them.

(vii) _____ Not applicable _____

(viii) _____ Not applicable _____

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice."

27. OPERATION

Paragraph 208.10(c)(2) of the prescribed regulations gives rules pertaining to flood walls during periods of flood emergency. These rules are quoted below.

"(2) Operation. - Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall."

28. EMERGENCY REPAIR MEASURES

The Superintendent or responsible members of his organization shall take immediate action to correct any condition which endangers the stability of the wall. All such measures taken will be reported to the Division Engineer immediately after the flood period.

(1) Sand Boils. - See Section V, Paragraph 21-b for emergency measures to be taken in the event sand boils develop.

(2) Raising Grade of Wall. - In an emergency, the walls may be raised temporarily by a single row of sandbags or by lumber topping (shown on Plate No. VII) with riverside stakes driven immediately behind the wall.

SECTION VIII

DRAINAGE STRUCTURE

29. DESCRIPTION

The 24-inch diameter corrugated metal bituminous coated pipe culvert through the right bank of the channel is provided to drain the interior surface water from the property of the Plymouth Rubber Company located in the vicinity of its Canrock and Plastics Buildings. A cast iron flap valve is provided on the river side of the dike.

30. MAINTENANCE

"Normal maintenance as required for this type of structure should be performed. Adequate measures shall be taken to insure that the flap valve is kept free of trash, drift or debris that would interfere with the operation of the flap valve, regular inspection shall be made by the Superintendent to be certain that:

(1) Pipes, gate, operating mechanism and riprap are in good condition.

(2) Inlet and outlet are open.

(3) Care is being exercised to prevent the accumulation of trash and debris near the structures, and that no fires are being built near the bituminous coated pipe.

(4) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections."

31. OPERATION

Whenever high water conditions impend the flap valve shall be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the valve shall be removed.

SECTION IX

INTAKE STRUCTURE

32. DESCRIPTION

The intake structure controls the flow of process water into the cooling water canal of the Plymouth Rubber Company. The structure contains a manually-operated sluice gate for a 24-inch cast iron pipe and has a small trash rack to catch debris. Short lengths of gravity wall tie the intake structure into the right bank and the abutment of the existing Plymouth Rubber Company dam. The gate must be closed as required during flood periods.

33. MAINTENANCE

Normal maintenance as required for this type of structure should be performed. Adequate measures shall be taken to insure that the intake structure is kept free of trash, drift or debris that would interfere with the operation of the gate. The manually-operated gate shall be examined, oiled and trial-operated at least once every 90 days. The trash rack should be kept free of all debris.

34. OPERATION

Whenever high water conditions impend, the gate shall be inspected and any object which might prevent closure of the gate shall be removed. During high river stages it is extremely important that the intake gate be closed as necessary to prevent the inflow of flood waters from impounding the area behind the structure and thereby inundate the Plymouth Rubber Company buildings.

SECTION X

DRAWINGS AND SPECIFICATIONS

35. DRAWINGS AND SPECIFICATIONS

A complete set of plans and specifications was furnished the Town of Canton, the Commonwealth of Massachusetts and other interested State Agencies at the time of initiation of construction of the project. A full-size set of plans showing the project as actually constructed was furnished the Town at the time of transmittal of this manual. Reduced prints of these drawings are included in Appendix D.

APPENDIX A

REGULATIONS OF THE SECRETARY OF THE ARMY

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, War Department

PART 208—FLOOD CONTROL REGULATIONS MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1936, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c-1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General*. (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the right-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the Superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance*. The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days; and such intermediate times as may be necessary to insure the best possible care of

the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation*. During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls*—(1) *Maintenance*. Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation*. Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance*. Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

APPENDIX B

ASSURANCES OF LOCAL COOPERATION

ASSURANCE
OF THE
COMMONWEALTH OF MASSACHUSETTS

Chapter 26B, Section 205 of the Flood Control Act approved 30 June 1948 amended by Section 212 of the Flood Control Act approved 17 May 1950, and further amended by Public Law 685, 84th Congress, 2nd Session, authorizes the Secretary of the Army "to allot from any appropriations heretofore or hereafter made for flood control, not to exceed \$10,000,000. for any one fiscal year, for the construction of small flood control projects not specifically authorized by Congress, and not within areas intended to be protected by projects as authorized, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable: Provided, that not more than \$400,000. shall be allotted for this purpose at any single locality from the appropriations for any one fiscal year: Provided further, that the provisions of local co-operation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply: and Provided further, that the work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports"; and

WHEREAS, the Secretary of the Army has allotted funds for construction of local protection project, East Branch, Neponset River, Canton, Massachusetts, according to plans prepared in the New England Division Office of the Corps of Engineers, United States Army; and

WHEREAS, the construction work is to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers, Corps of Engineers, United States Army; and

WHEREAS, said flood diversion channel improvement is subject to the provisions of Section 3 of the Flood Control Act of 22 June 1936 which provides that no money will be expended on the construction of any project until States, political subdivisions thereof, or other responsible local agencies have given certain Assurances to the Secretary of the Army; and

WHEREAS, the Department of Public Works of the Commonwealth of Massachusetts under Chapter 763 of the Acts of 1957 has been provided with funds necessary to underwrite local participation in federal flood control projects and to commit such funds toward payment of any costs in excess of the sum of \$400,000. available for federal expenditures.

NOW, THEREFORE, the Commonwealth of Massachusetts, acting by and through its Department of Public Works, hereby assures the United States that it will contribute all construction funds that are found to be necessary over and above the federal expenditure limitation if such additional funds are required to provide for a complete and effective project.

PROVIDED, that such contribution from the Commonwealth of Massachusetts shall not be in excess of the amount appropriated by Item 8258-76-00 of Chapter 763 of the Acts of 1957.

IN WITNESS WHEREOF, the Commonwealth of Massachusetts has executed the within Assurance this 21st day of October, 1961.

Approval Recommended:

[Signature]
Director,
Division of Waterways

COMMONWEALTH OF MASSACHUSETTS

BY [Signature]
Commissioner, Department of
Public Works

Approved as to matters of form:

[Signature]
Assistant Attorney General

[Signature]
Associate Commissioner,
Department of Public Works

[Signature]
Associate Commissioner

ACCEPTANCE

[Signature] 1961

The within Assurance is hereby accepted for and on behalf of the United States of America.

[Signature]
SEYMOUR A. POTTER, JR.
Brigadier General, USA
Division Engineer

ASSURANCE
OF THE
TOWN OF CANTON, MASSACHUSETTS

WHEREAS, Section 205 of the Flood Control Act approved 30 June 1948 amended by Section 212 of the Flood Control Act approved 17 May 1950, and further amended by Public Law 685, 84th Congress, 2nd Session, authorizes the Secretary of the Army "to allot from any appropriations heretofore or hereafter made for flood control, not to exceed \$10,000,000. for any one fiscal year, for the construction of small flood control projects not specifically authorized by Congress, and not within areas intended to be protected by projects so authorized, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable: Provided, that not more than \$400,000. shall be allotted for this purpose at any single locality from the appropriations for any one fiscal year: Provided further, that the provisions of local co-operation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply: and Provided further, that the work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports"; and

WHEREAS, the Secretary of the Army has allotted funds for construction of local protection project, East Branch, Neponset River, Canton, Massachusetts, according to plans prepared in the New England Division Office of the Corps of Engineers, United States Army; and

WHEREAS, the construction work is to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers, Corps of Engineers, United States Army; and

WHEREAS, said flood diversion channel improvement is subject to the provisions of Section 3 of the Flood Control Act of 22 June 1936 which provides that no money will be expended on the construction of any project until States, political subdivisions thereof, or other responsible local agencies have given certain Assurances to the Secretary of the Army; and

WHEREAS, there may be certain utility lines, sewers, and drains located within the necessary right-of-way required for the construction of the project.

NOW, THEREFORE, the Town of Canton, Massachusetts, acting by and through its Board of Selectmen, hereby assures the United States that it will:

- (a) Provide without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the project.
- (b) Hold and save the United States free from damages due to the construction works.
- (c) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.
- (d) Contribute all construction funds that are found to be necessary over and above the sum of \$400,000. if such additional funds are required to provide and complete an effective project.
- (e) Arrange for and bear the cost of the relocation of all utility lines, sewers, and drains where they interfere with the proposed work.
- (f) Make cash contribution for entire project costs assigned to features other than flood control. These features consist of the construction of a water diversion dam; the modification of an existing dam, the construction of a water intake structure, and the construction of a wall along the right-of-way on the right bank of the river immediately upstream of the existing dam.

IN WITNESS WHEREOF, the Town of Canton, Massachusetts, through its Board of Selectmen executed the foregoing Assurance and caused the seal of said Town to be affixed hereto this 15th day of February, 1962.

TOWN OF CANTON, MASSACHUSETTS
BY ITS BOARD OF SELECTMEN

Frank J. Carroll
CHAIRMAN

Maurice E. Ronayne
MEMBER

[Signature]
MEMBER

ACCEPTANCE

[Signature] 1962.

The within Assurance is hereby accepted for and on behalf of the United States of America.

[Signature]
REYNOLD A. POTTER, JR.
Brigadier General, USA
Division Engineer

APPENDIX C

INSPECTION REPORT FORMS

APPENDIX C

INSPECTION REPORT FORMS

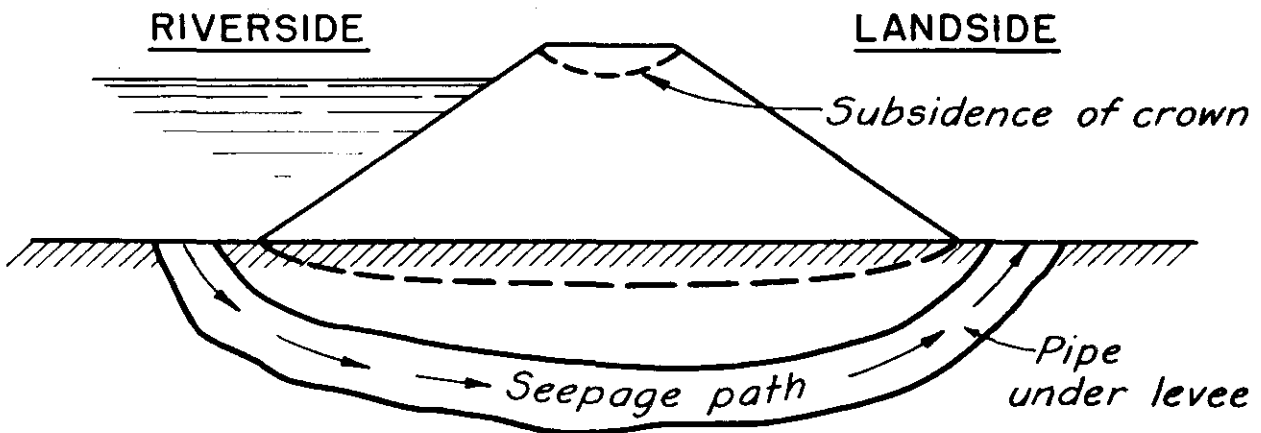
FLOOD PROTECTION SYSTEM INSPECTION REPORT		LOCATION
DIVERSION CHANNEL		LOCATION AND DESCRIPTION OF DEFICIENCIES
Grass or sod		
Caving banks or erosion		
Burrowing animals		
Sand boils		
Stone slope protection		
Trespassing		
Vegetaion growth shoaling or other encroachment		
General condition of channel		
Flap valves & culverts		
DIVERSION DAM		
Caving or erosion		
General condition		
Sand boils		
Concrete walls		
1. Availability of Sand and Sand Bags		
2. Have all deficiencies noted in previous reports been corrected?		
REMARKS		
Date	Inspected by: Typed Name & Title	Signature
Check items if found satisfactory, otherwise list deficiencies.		

FLOOD PROTECTION SYSTEM INSPECTION REPORT		LOCATION
DIKE INSPECTION		LOCATION AND DESCRIPTION OF DEFICIENCIES
Grass or Sod		
Caving banks or erosion		
Burrowing animals		
Sand boils		
Stone slope Protection		
Trespassing		
INTAKE WELLS		
Concrete		
Trash Racks and Gates		
CONCRETE WALL INSPECTION		
Wall		
Cracks		
Settlement		
Joints		
Spalling		
Stone Slope Protection		
Water Stops		
Remarks:		
Date	Inspected by: Typed Name & Title	Signature
Check items if found satisfactory, otherwise list deficiencies.		

APPENDIX D

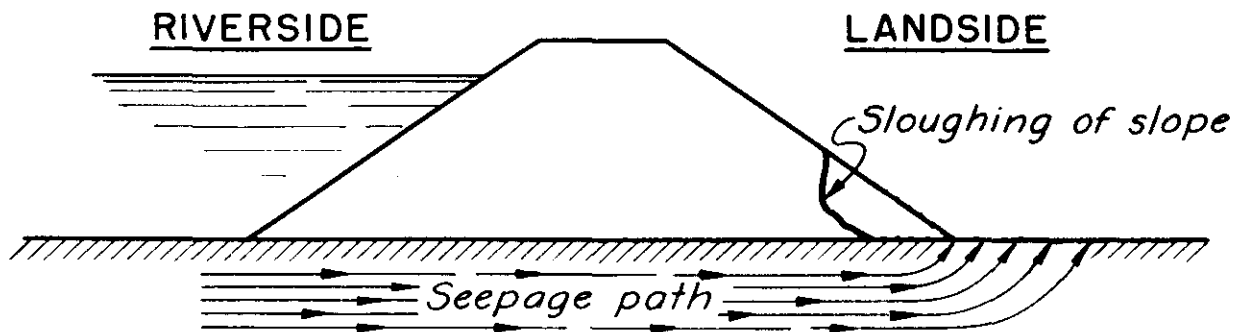
FLOOD EMERGENCY MEASURES

EFFECTS OF SAND BOILS ON LEVEE



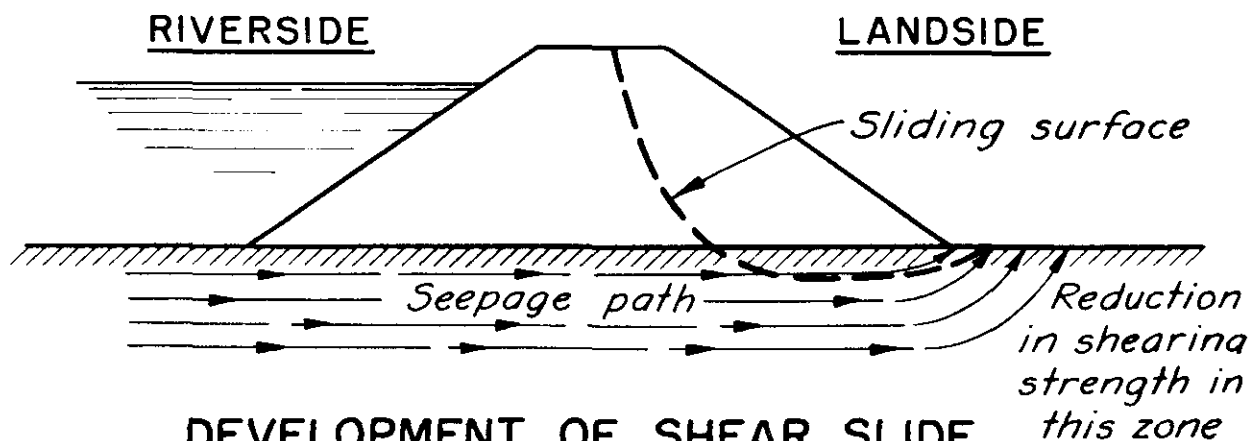
DEVELOPMENT OF PIPE UNDER LEVEE

Fig. 1



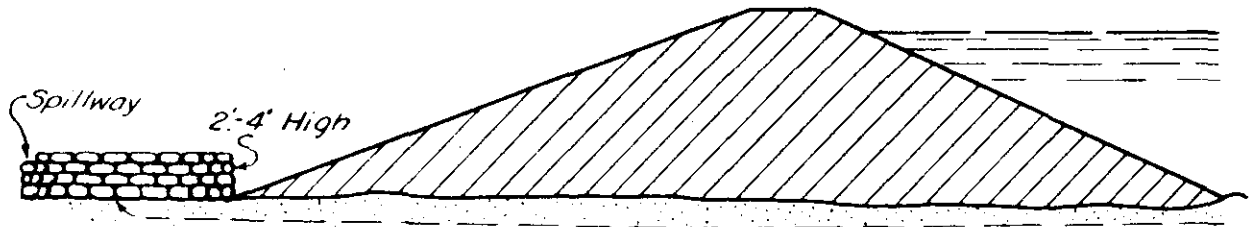
SLOUGHING OF LANDSLIDE SLOPE DUE TO RAVELLING AND UNDERCUTTING OF TOE

Fig. 2

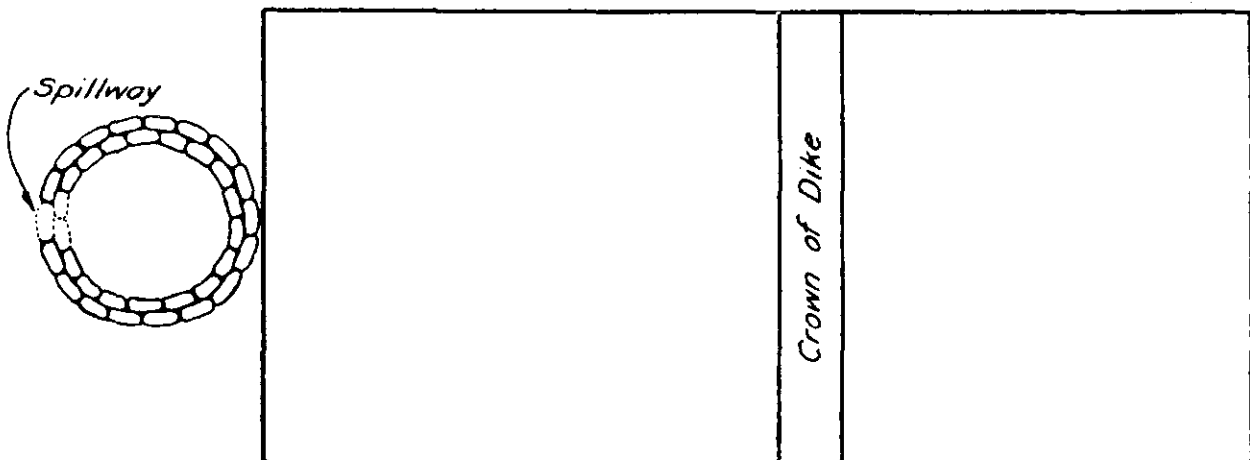


DEVELOPMENT OF SHEAR SLIDE

Fig. 3



Wall should be built on firm ELEVATION
 foundation, with width of base
 at least $1\frac{1}{2}$ times the height.
 Be sure to place sacks on ground
 clear of sand discharge.
 Tie into dike if boil is near toe.

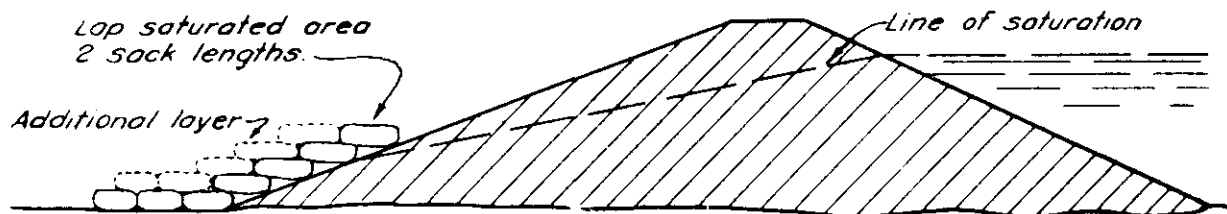


PLAN

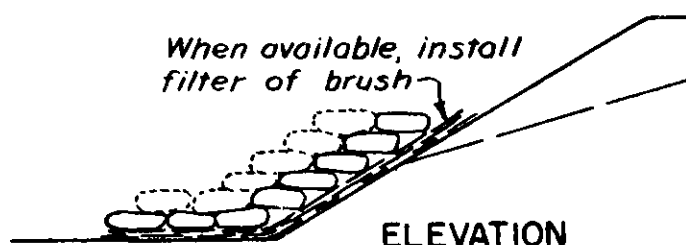
*Do not sack boil which
 does not put out material.
 Height of sack loop or ring
 should be only sufficient to
 create enough head to slow
 down flow through boil so
 that no more material is dis-
 placed and boil runs clear.
 Do not try to stop fully, flow
 through boil.*

**SAND BOIL
 STANDARD HIGH WATER
 MAINTENANCE INSTRUCTION**

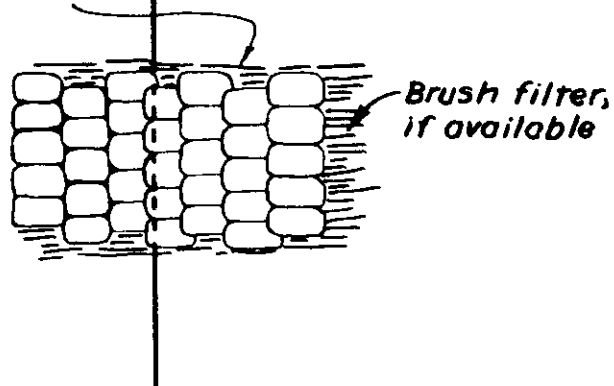
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
 CORPS OF ENGINEERS WALTHAM, MASS.

ELEVATION

Number of layers determined by velocity of seepage and amount of material being carried

ELEVATION

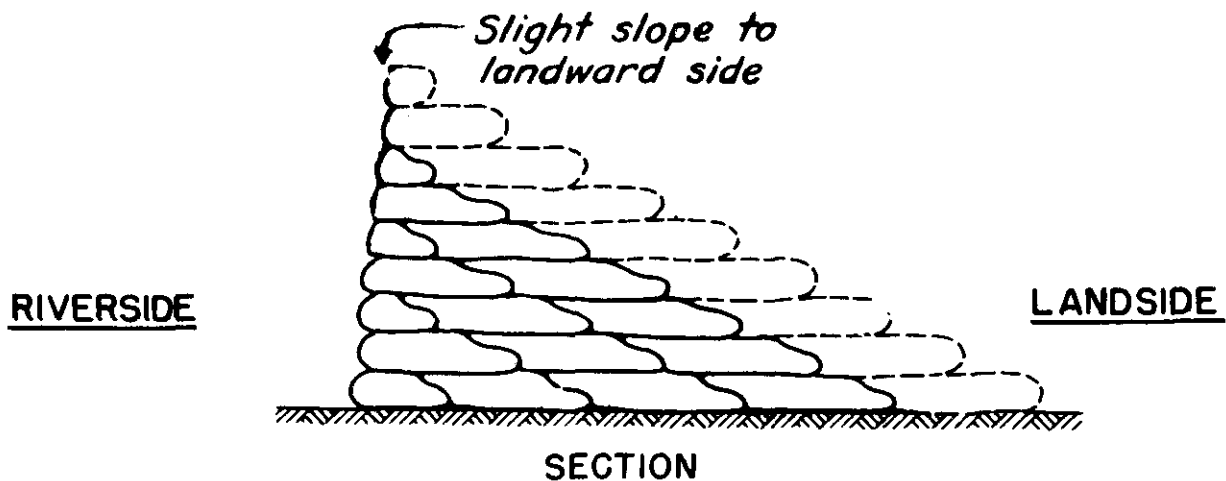
Lap saturated area 2 sack widths on both ends.

PLAN

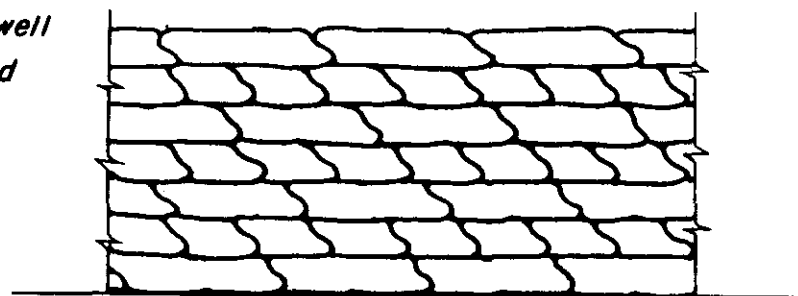
Sacks should be laid shingle fashion and not moulded into place.

SACKING SLOUGHS STANDARD HIGH WATER MAINTENANCE INSTRUCTION

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.



Note: Sacks should be lapped at least 1/3 all ways and well mauled or tamped into place.

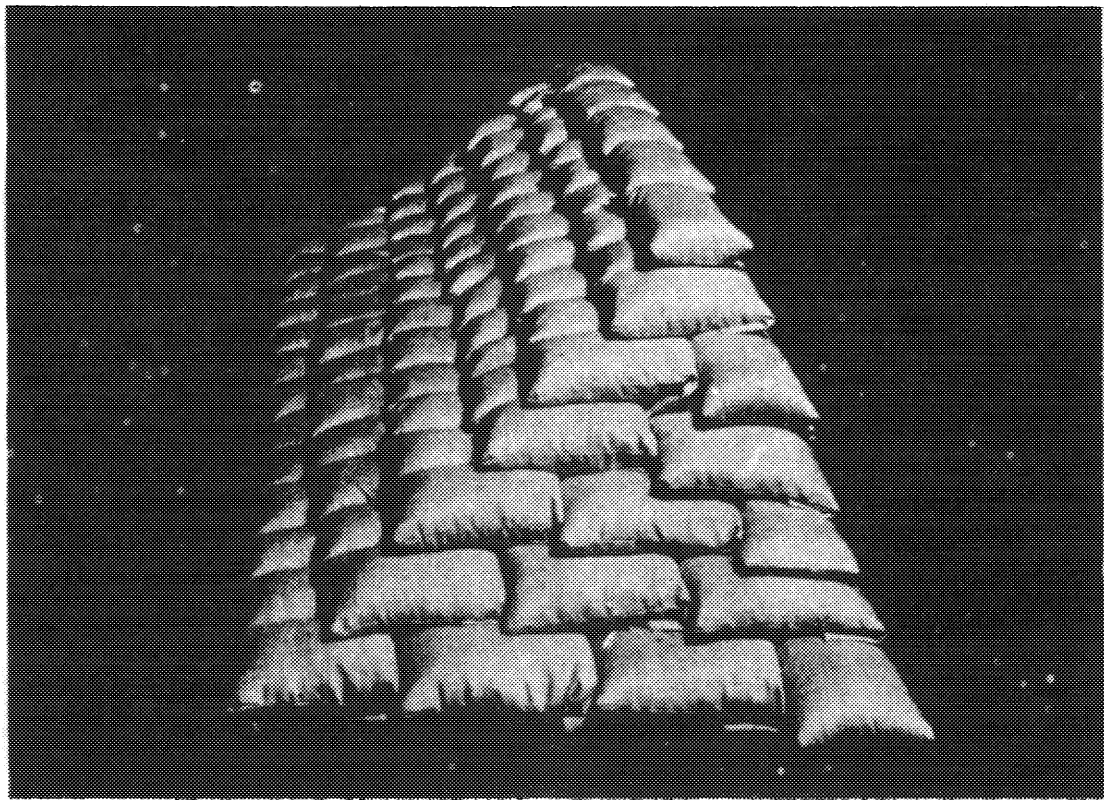


SACKS REQUIRED PER 100' STA.
100 lb. "Feed" Sacks - 1 Cu. Ft. Each

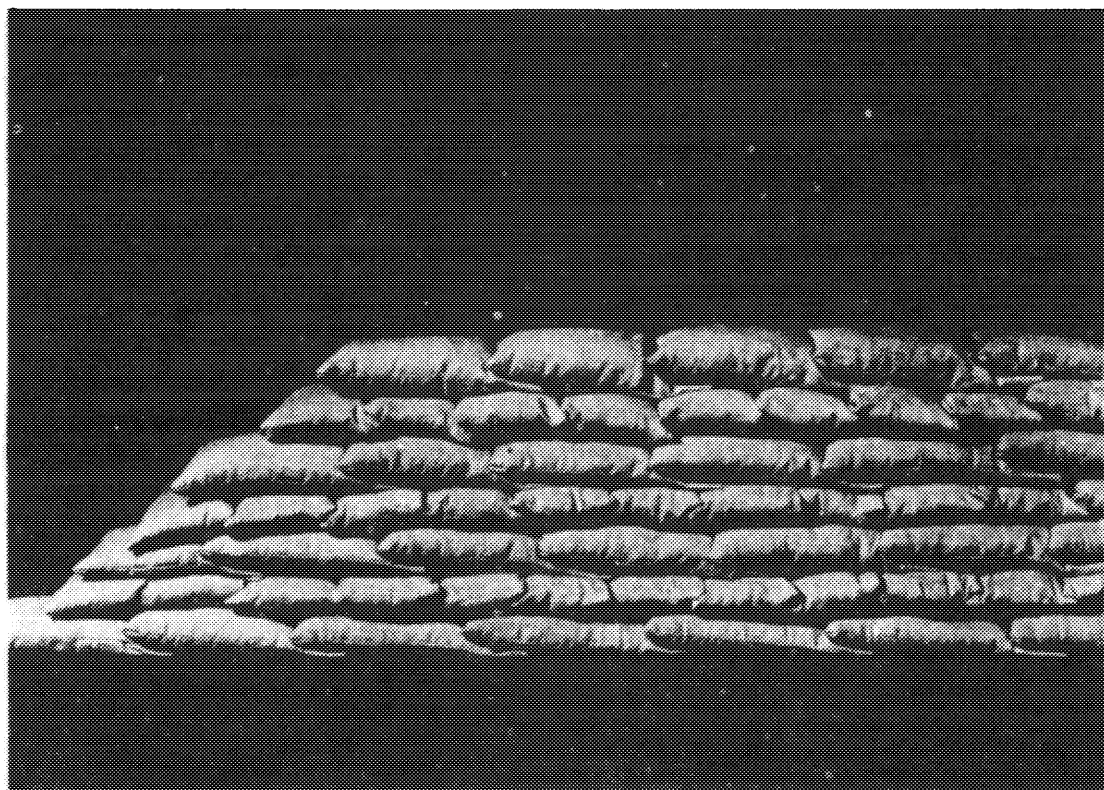
Approx. Hgt. Sack Dike	Sacks High	Required
1.5	3	300
2.0	4	750
3.0	6	1400
4.0	8	2250
5.0	10	3250
6.0	12	4500
7.0	14	5950
8.0	16	7600

SACK DIKE OR TOPPING
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

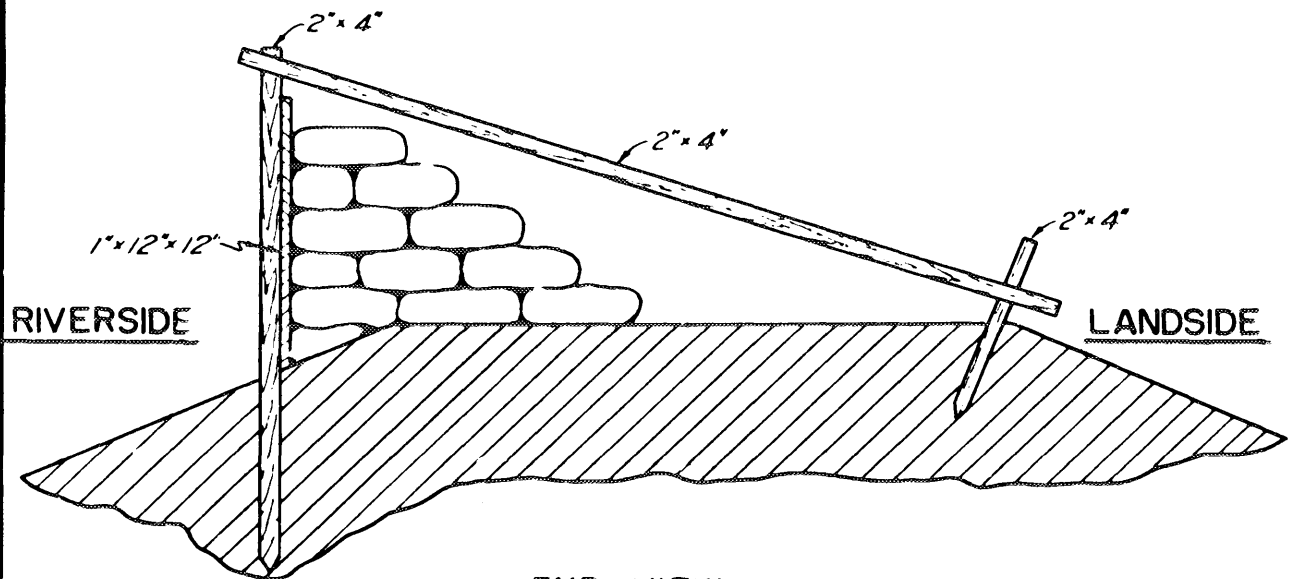
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.



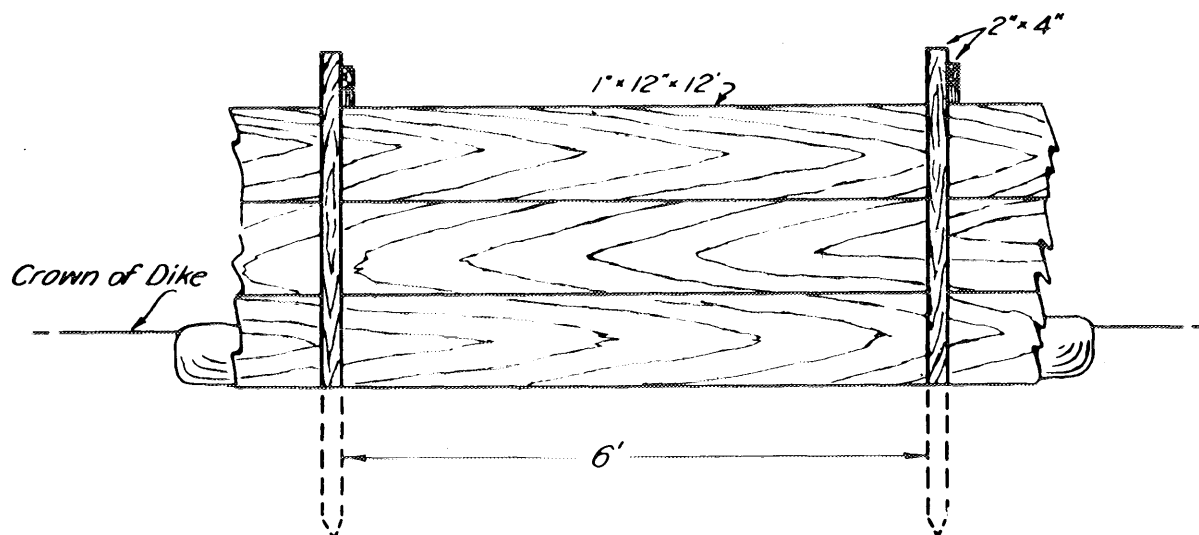
MODEL SACK DIKE OR TOPPING
Typical Section



MODEL SACK DIKE OR TOPPING
Riverside View



END VIEW



FRONT ELEVATION

BILL OF MATERIAL TO CONSTRUCT 100 FEET

25 pcs. 1" x 12" x 12'

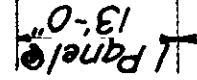
17 pcs. 2" x 4" x 6'

17 pcs. 2" x 4" x 10'

17 pcs. 2" x 4" x 2'

**LUMBER AND SACK TOPPING
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION**

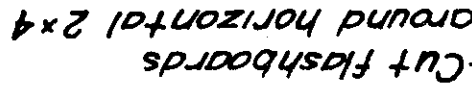
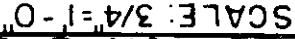
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.



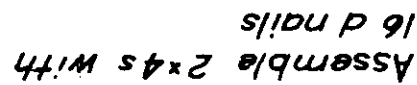
SCALE: 1/16" = 1'-0"



FLASHBOARDS



SCALE: 3/4"=1'-0"



NOTE:

Top of wall
-Wedge between
vert. 2x4 and
wall.

APPENDIX 2

AS-BUILT DRAWINGS

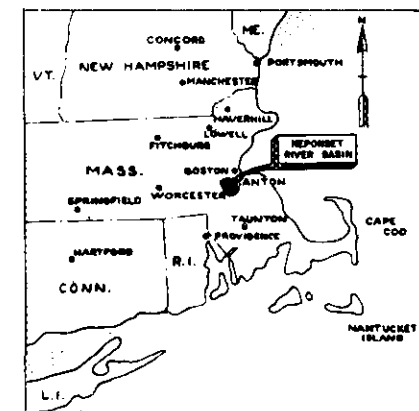
VINCINITY MAP

SCALE IN MILES

1. 25,000



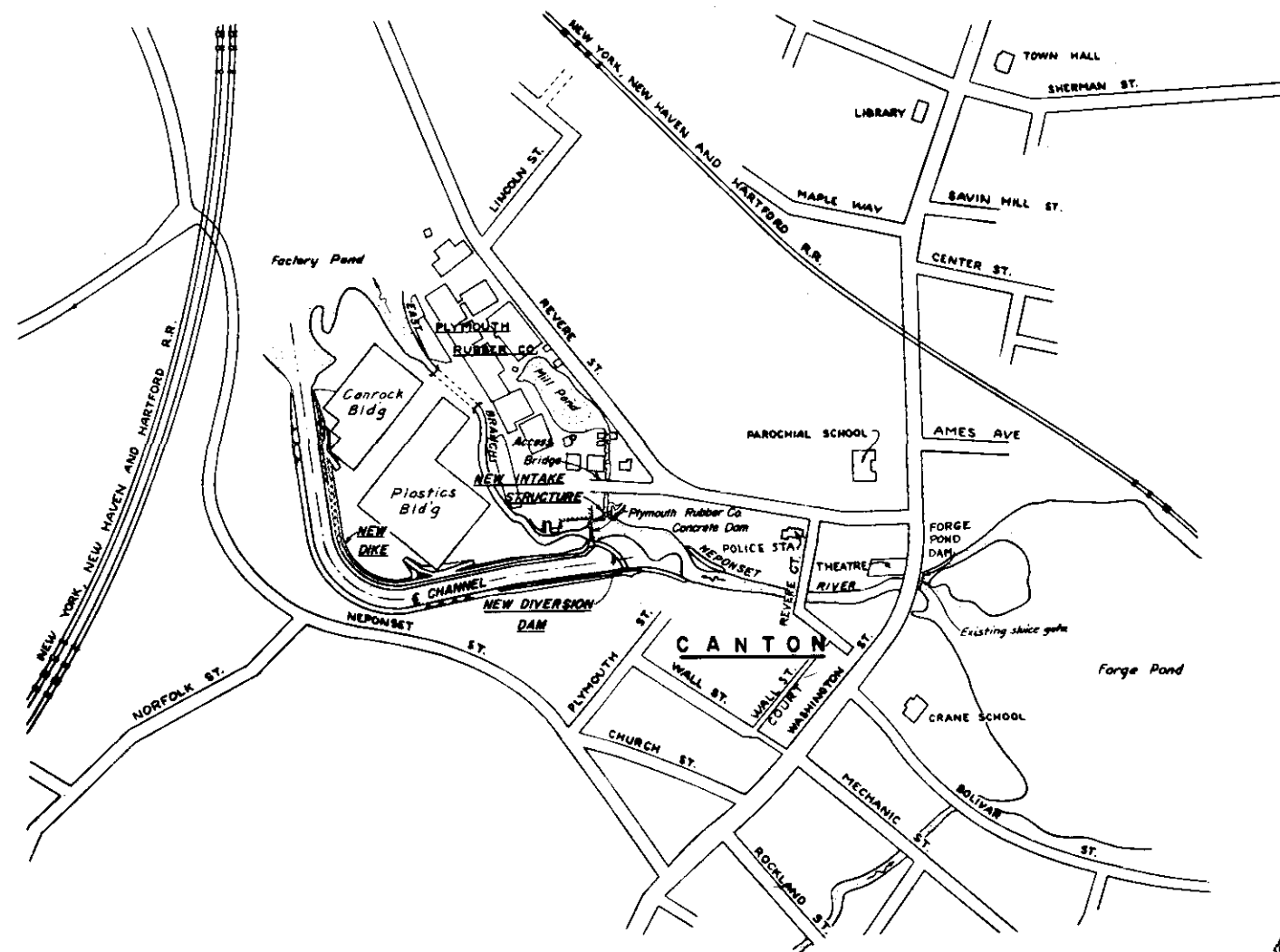
INDEX TO DRAWINGS		
DRAWING NO	SHEET NO	TITLE
NEP-I-1001	1	PROJECT PLAN AND INDEX
NEP-I-1002	2	GENERAL PLAN
NEP-I-1003	3	PROFILE AND EXPLORATIONS
NEP-I-1004	4	INTAKE STRUCTURE AND SECTIONS
NEP-I-1005	5	DIVERSION DAM AND MISCELLANEOUS SECTIONS
NEP-I-1006	6	CHANNEL SECTIONS AND DETAILS
NEP-I-1007	7	HYDROGRAPHS AND RATING CURVES



LOCATION MAP

SCALE IN MILES

0 20 40 60



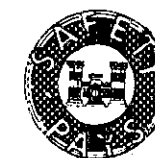
PROJECT PLAN

SCALE 1"=200'

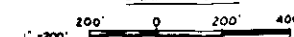


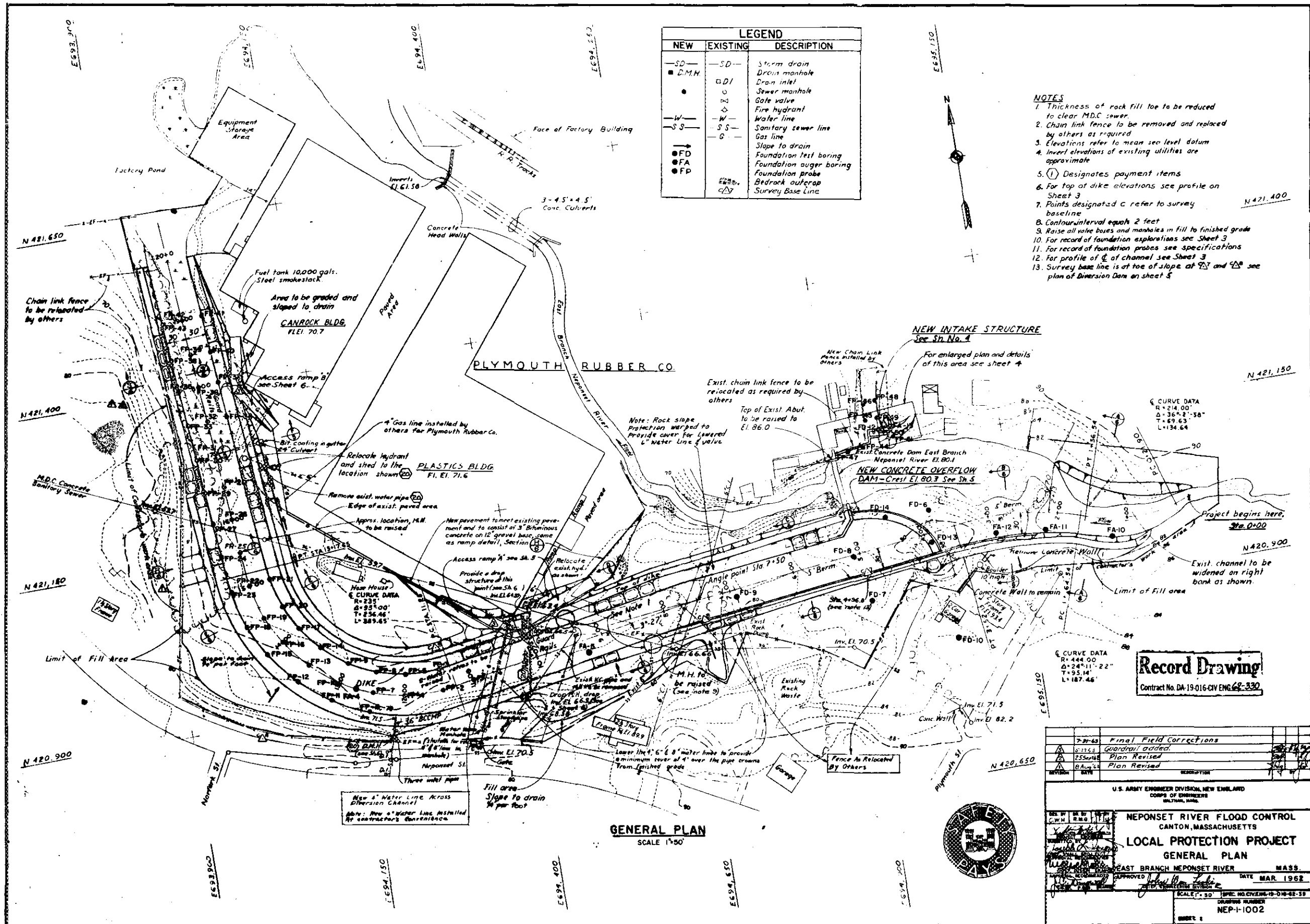
Record Drawing

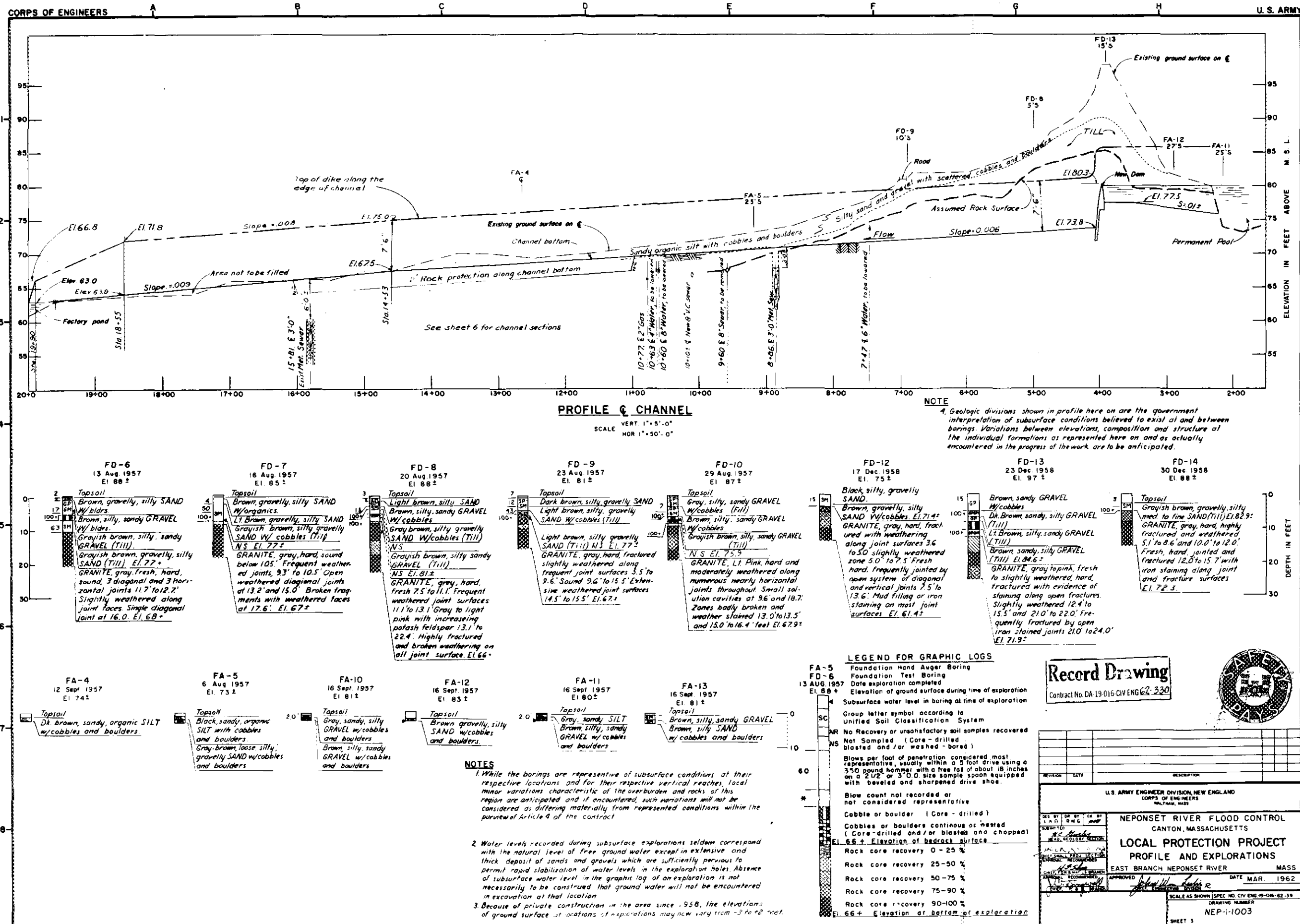
Contract No. DA-19-016-CIV ENG 62-330



GRAPHIC SCALE

[illegible]

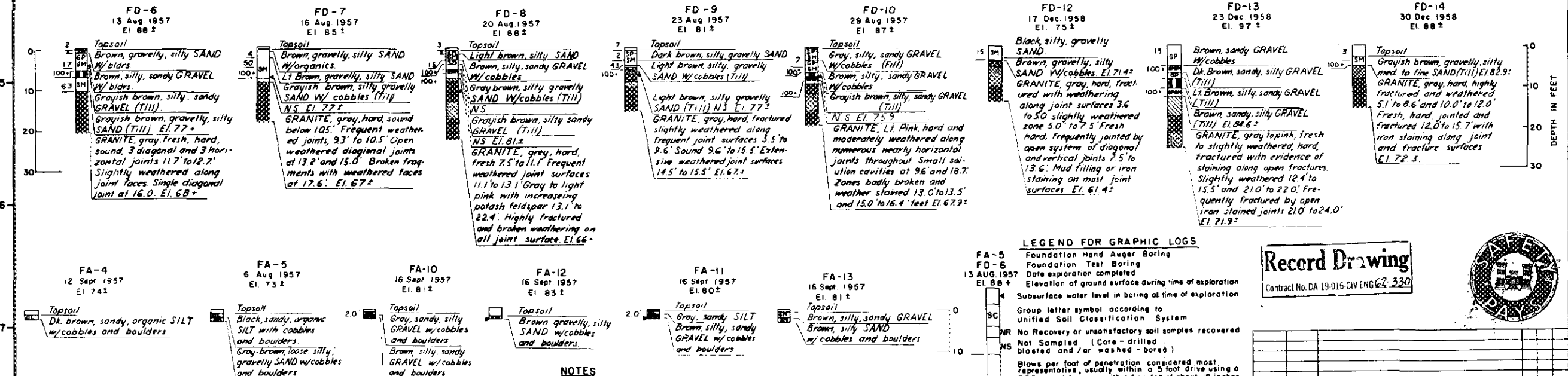




PROFILE & CHANNEL

SCALE VERT. 1"=5'-0" HOR. 1"=50'-0"

NOTE
4. Geologic divisions shown in profile here on are the government interpretation of subsurface conditions believed to exist at and between borings. Variations between elevations, composition and structure at the individual formations as represented here on and as actually encountered in the progress of the work are to be anticipated.



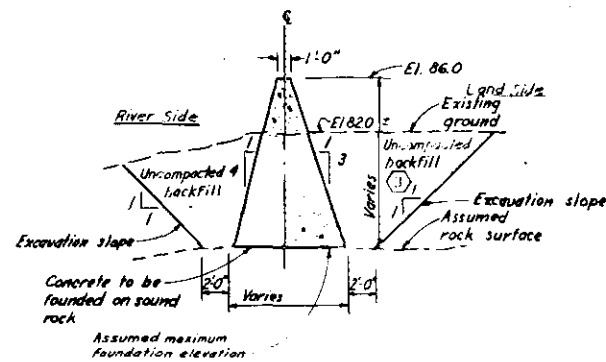
NOTES
1. While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local minor variations characteristic of the overburden and rocks of this region are anticipated, and if encountered, such variations will not be considered as differing materially from represented conditions within the purview of Article 4 of the contract.
2. Water levels recorded during subsurface explorations seldom correspond with the natural level of free ground water except in extensive and thick deposit of sands and gravels which are sufficiently pervious to permit rapid stabilization of water levels in the exploration holes. Absence of subsurface water level in the graphic log of an exploration is not necessarily to be construed that ground water will not be encountered in excavation at that location.
3. Because of private construction in the area since 1958, the elevations of ground surface at locations of explorations may now vary from -3 to +2 feet.

LEGEND FOR GRAPHIC LOGS
FA-5 Foundation Hand Auger Boring
FD-6 Foundation Test Boring
13 AUG 1957 Date exploration completed
El. 88 ± Elevation of ground surface during time of exploration
Subsurface water level in boring at time of exploration
Group letter symbol according to Unified Soil Classification System
NR No Recovery or unsatisfactory soil samples recovered
NS Not Sampled (Core - drilled, blasted and/or washed - bored)
Blows per foot of penetration considered most representative, usually within a 5 foot drive using a 350 pound hammer with a free fall of about 18 inches on a 2 1/2" or 3" O.D. size sample spoon equipped with beveled and sharpened drive shoe.
Blow count not recorded or not considered representative
Cobble or boulder (Core - drilled)
Cobbles or boulders continuous or nested (Core - drilled and/or blasted and/or chipped)
El. 66 ± Elevation of bedrock surface
Rock core recovery 0 - 25 %
Rock core recovery 25 - 50 %
Rock core recovery 50 - 75 %
Rock core recovery 75 - 90 %
Rock core recovery 90 - 100 %
El. 66 ± Elevation at bottom of exploration

Record Drawing
Contract No. DA 19-016 CIV ENG 62-320

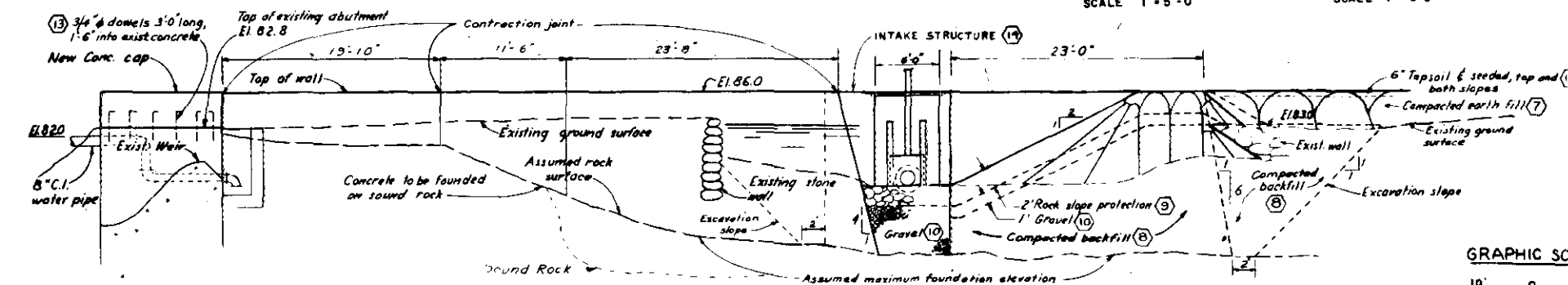
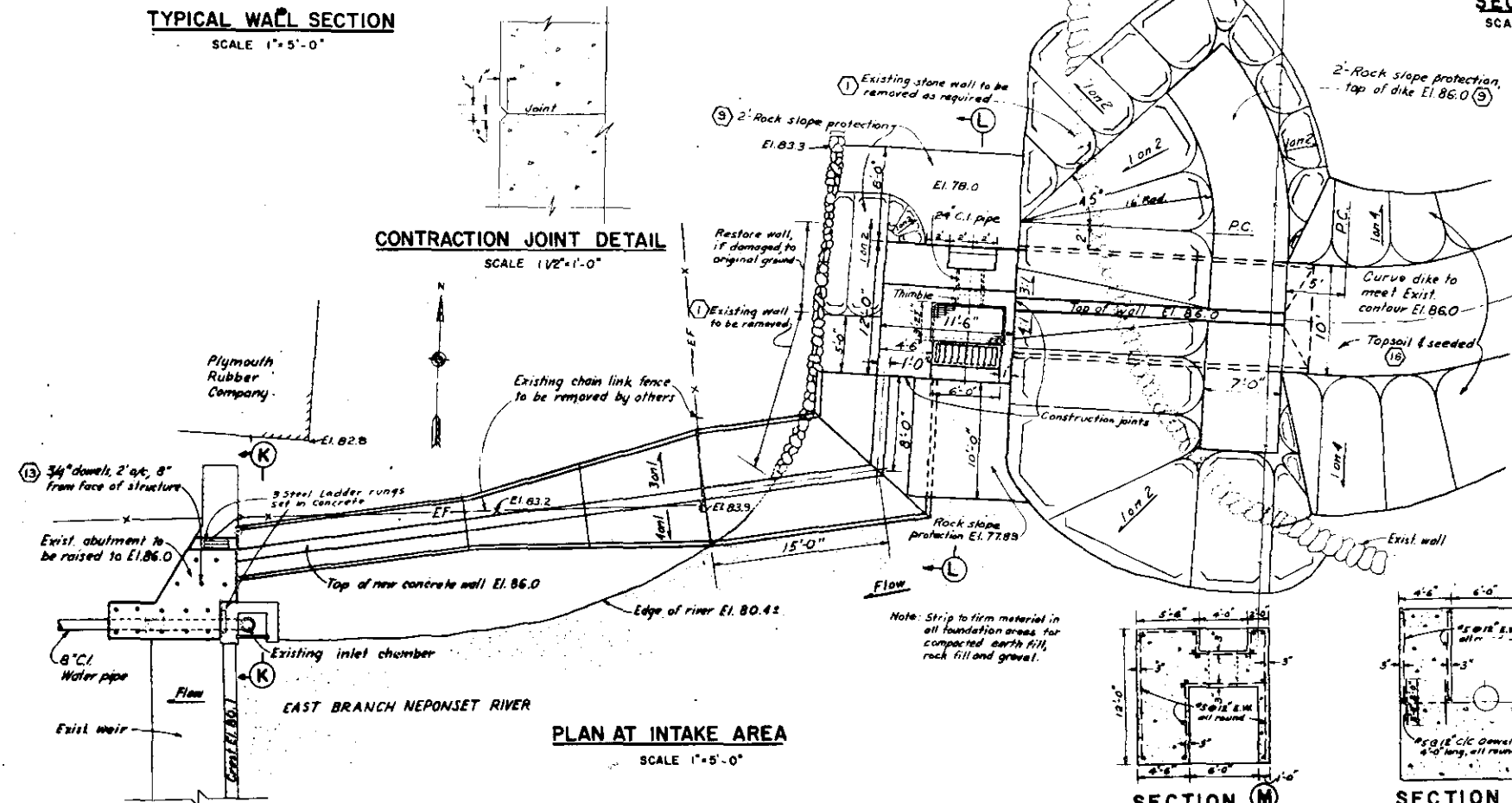
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
MILITARY DISTRICT, MASS.

NEPONSET RIVER FLOOD CONTROL
CANTON, MASSACHUSETTS
LOCAL PROTECTION PROJECT
PROFILE AND EXPLORATIONS
EAST BRANCH NEPONSET RIVER MASS
DATE MAR 1962
SCALE AS SHOWN (SPEC. NO. CIV ENG-9-OM-62-39)
DRAWING NUMBER
NEP-1-1003
SHEET 3



TYPICAL WALL SECTION
SCALE 1"=5'-0"

CONTRACTION JOINT DETAIL
SCALE 1/2"=1'-0"



SECTION (K)
SCALE 1"=5'-0"

SECTION (M)
SCALE 1"=5'-0"

SECTION (N)
SCALE 1"=5'-0"

SECTION (L)
SCALE 1"=5'-0"

GRATING (14)
SCALE 3/4"=1'-0"

ELEVATION

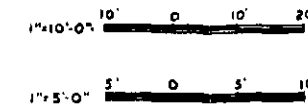
SECTION (P)

TRASH RACK (15)
SCALE 1/8"=1'-0"

Record Drawing

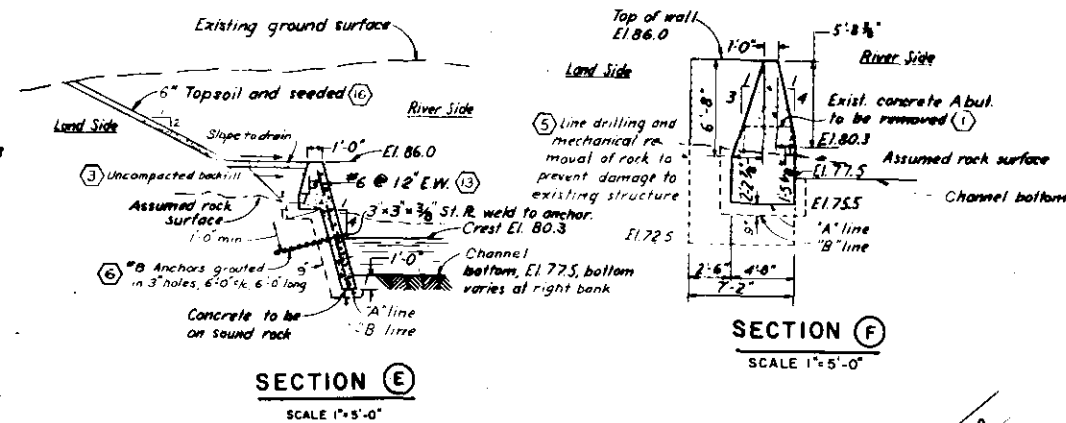
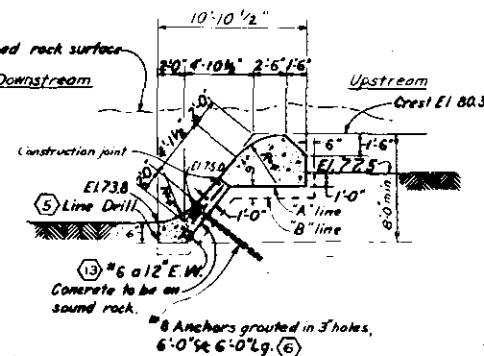
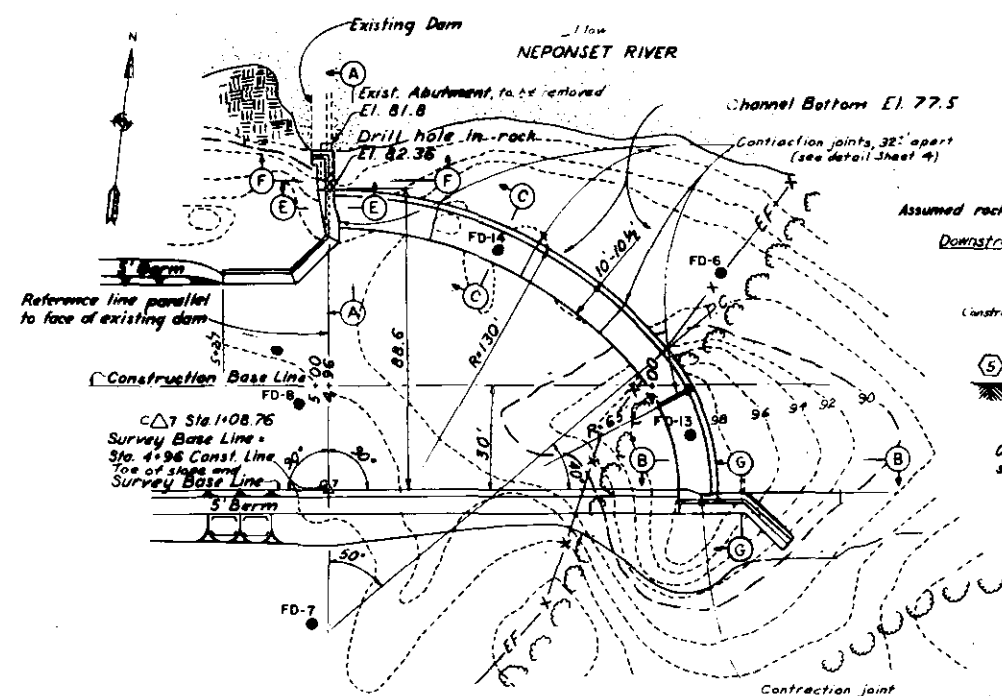
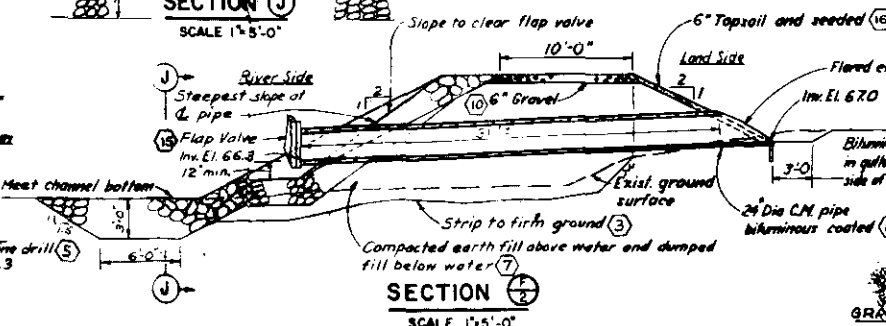
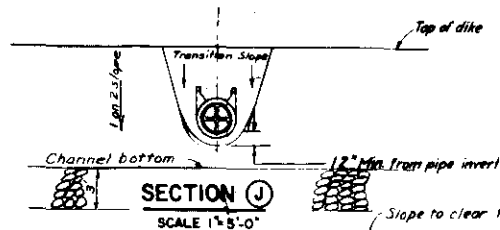
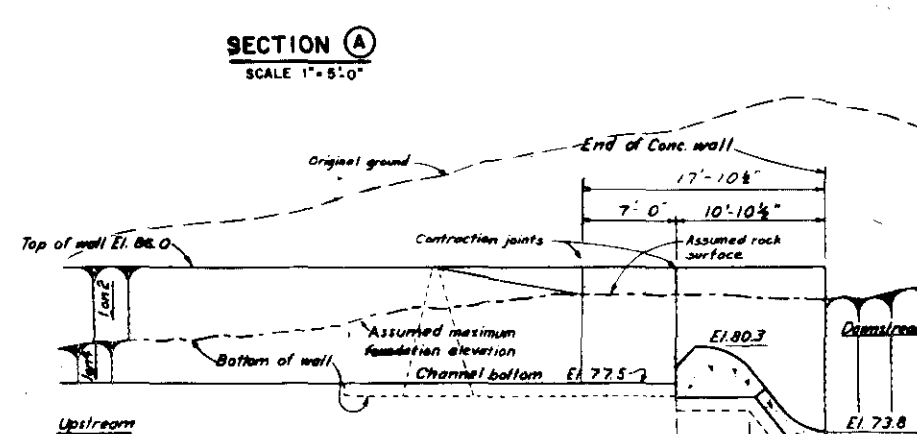
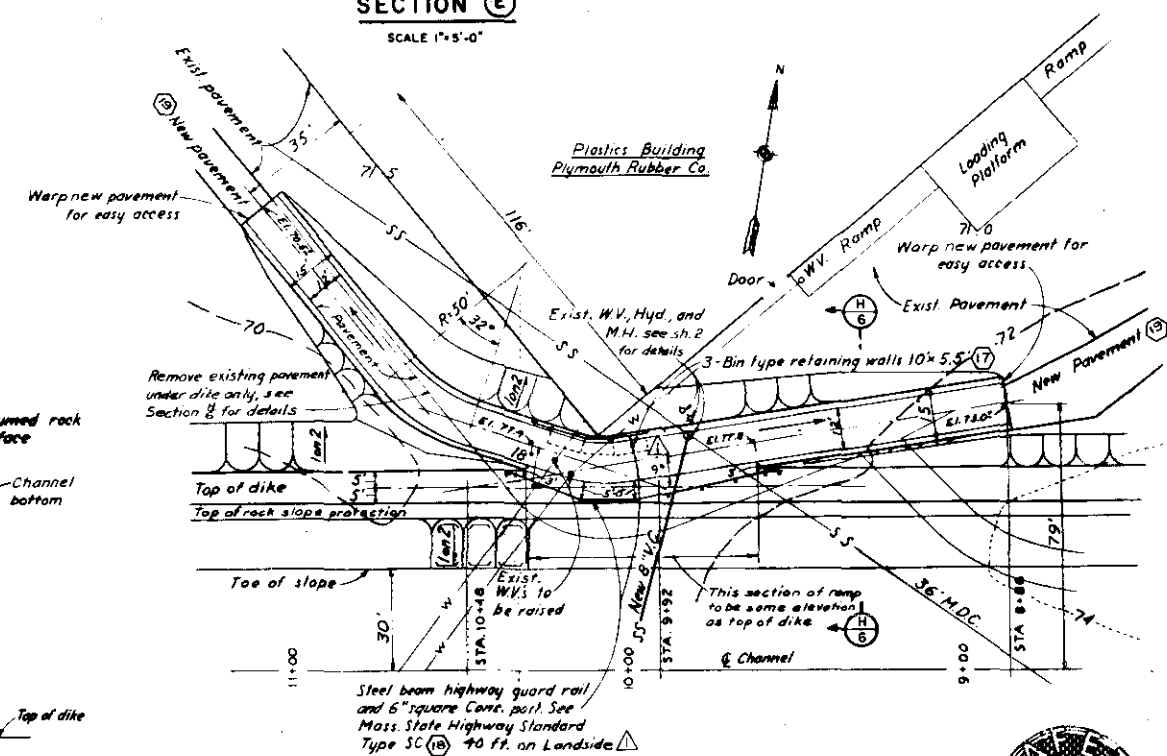
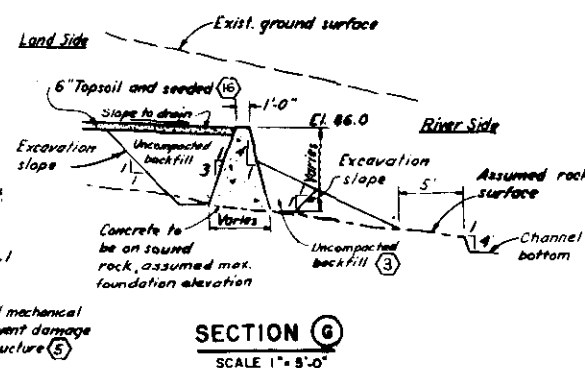
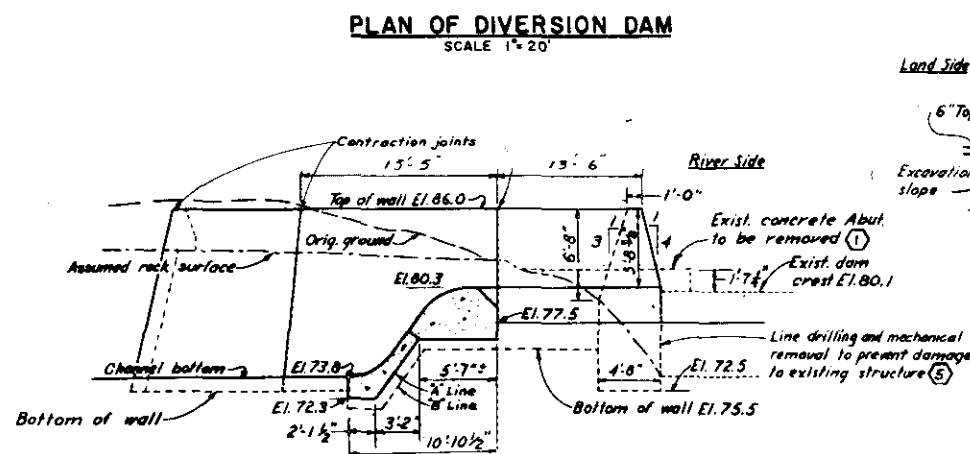
Contract No. DA-19-016-CIV-ENG-62-330

GRAPHIC SCALES



REVISION		DATE	DESCRIPTION
1		8-1-63	Final Field Corrections

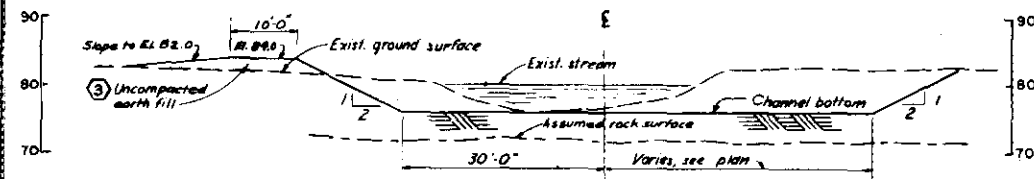
U. S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	
NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS	
LOCAL PROTECTION PROJECT INTAKE STRUCTURE AND SECTIONS	
EAST BRANCH NEPONSET RIVER	
APPROVED	DATE MAR. 1962
DRAWING NUMBER	
SHEET 4	

SECTION F
SCALE 1"=5'-0"PLAN OF ACCESS RAMP A
SCALE 1"=20'-0"

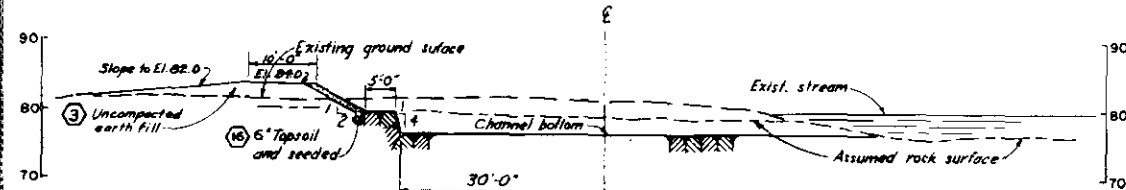
Record Drawing

Contract No. DA19-63-00000000-00000000

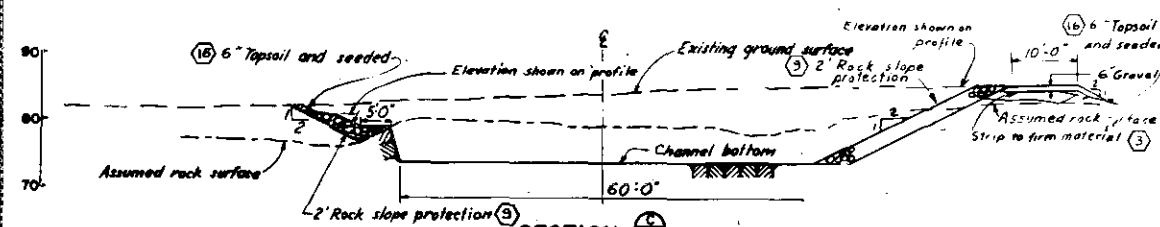
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS BOSTON, MASS.			
NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS			
LOCAL PROTECTION PROJECT DIVERSION DAM & MISC. SECTIONS			
EAST BRANCH NEPONSET RIVER		MASS.	
DATE MAR 1962		DRAWING NUMBER	
SHEET 5		NEP-1-1005	



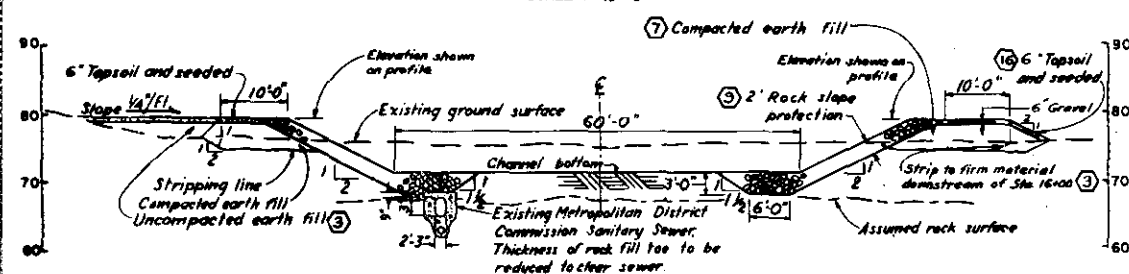
SECTION 1
TYPICAL CHANNEL CROSS SECTION IN EARTH ABOVE DAM
SCALE 1"=10'-0"



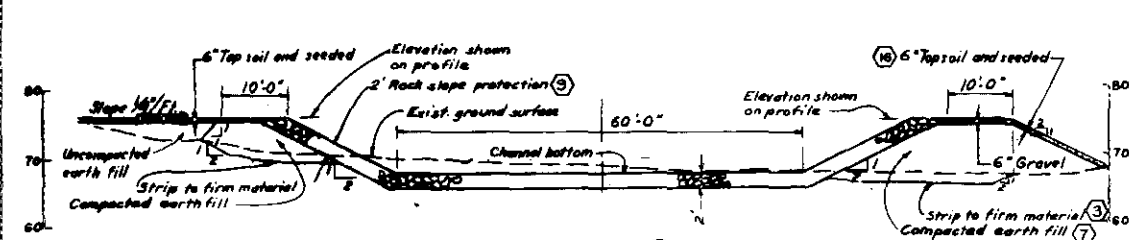
SECTION 2
TYPICAL CHANNEL CROSS SECTION IN ROCK ABOVE DAM
SCALE 1"=10'-0"



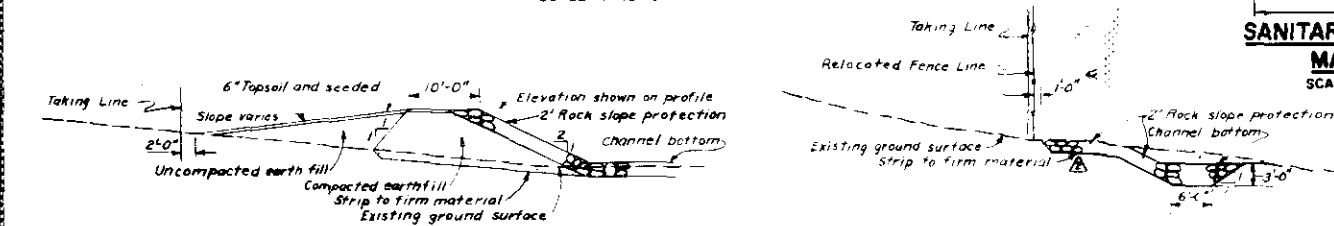
SECTION 3
TYPICAL CHANNEL CROSS SECTION IN ROCK CUT
SCALE 1"=10'-0"



SECTION 4
TYPICAL CHANNEL CROSS SECTION IN EARTH CUT BETWEEN STA 11+00 AND DAM AND DOWNSTREAM FROM STATION 16+00-RIGHT BANK ONLY
SCALE 1"=10'-0"

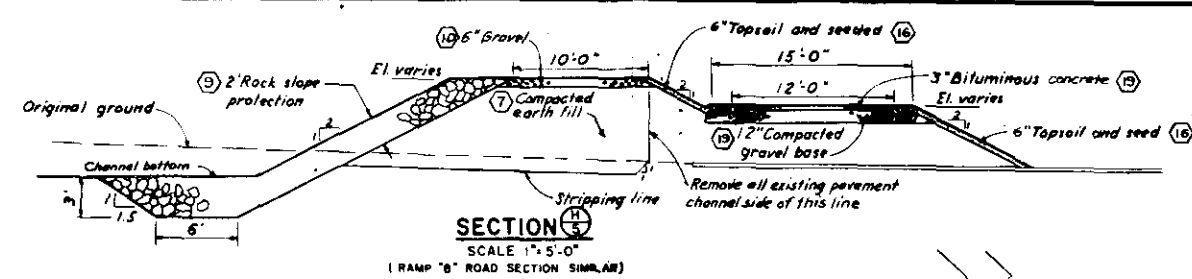


SECTION 5
TYPICAL CHANNEL CROSS SECTION IN EARTH CUT BETWEEN STATIONS 11+00 AND 14+70
SCALE 1"=10'-0"

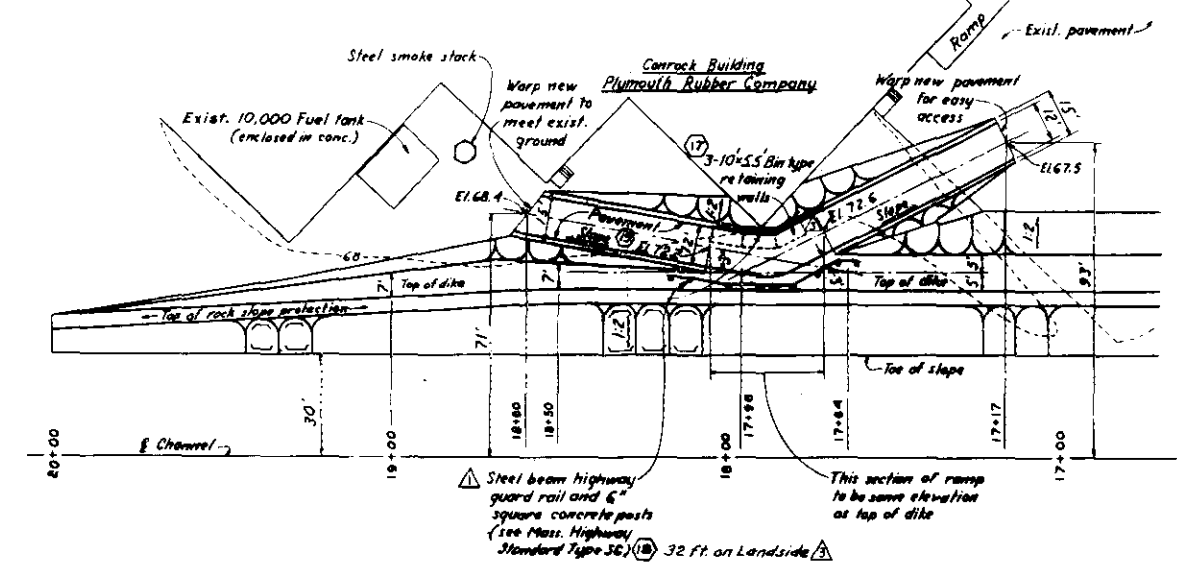


SECTION 6
TYPICAL SECTION LEFT BANK - STA. 14+70 TO 16+50
SCALE 1"=10'-0"

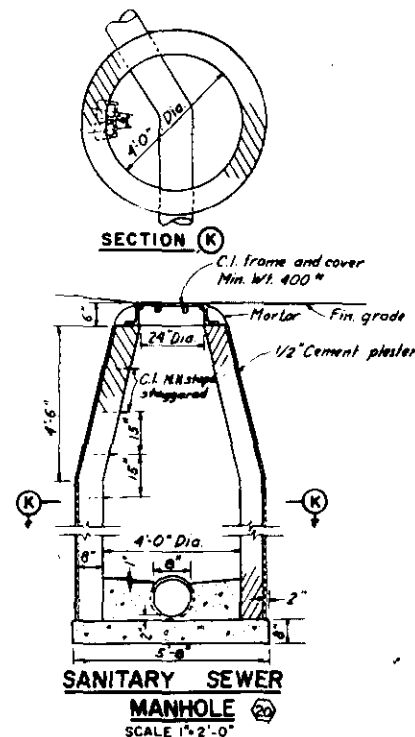
SECTION 7
TYPICAL SECTION LEFT BANK - STA. 16+50 TO 19+90
SCALE 1"=10'-0"



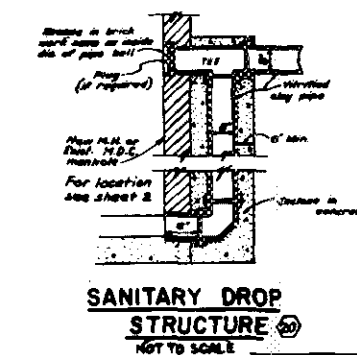
SECTION 8
PLAN OF ACCESS RAMP "B"
SCALE 1"=20'-0"



PLAN OF ACCESS RAMP "B"
SCALE 1"=20'-0"

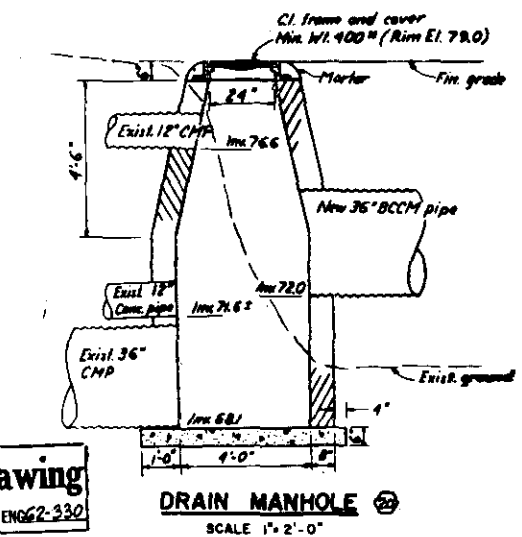


SANITARY SEWER
MANHOLE
SCALE 1"=2'-0"



SANITARY DROP
STRUCTURE
NOT TO SCALE

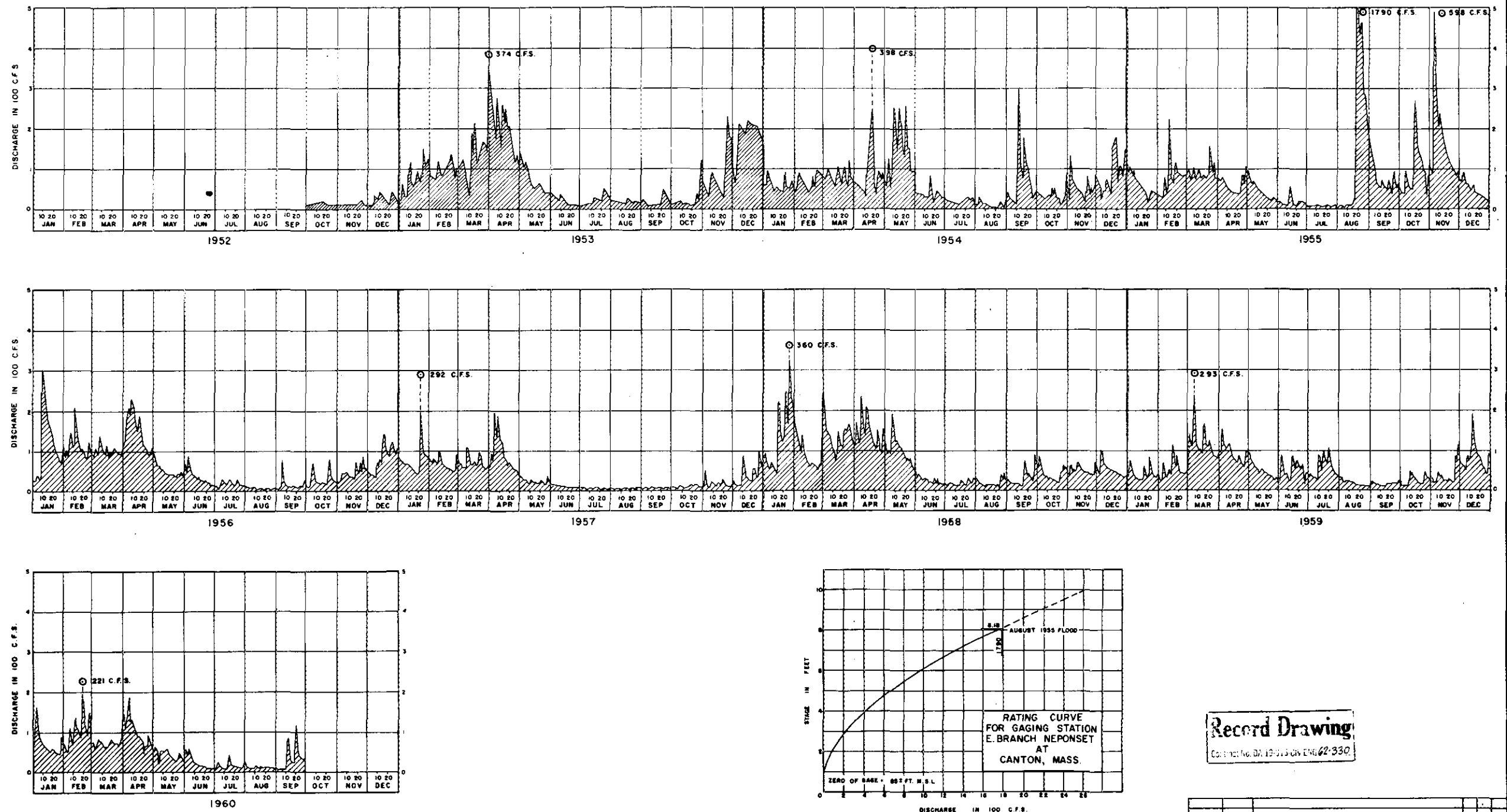
Record Drawing
Contract No. DA-19-016-CIV-ENG-2-330



DRAIN MANHOLE
SCALE 1"=2'-0"

NOTE:
From Sta 11+00 to the downstream end of channel, place compacted earth fill above water table, and dumped earth fill below water table.

7-2-40	Final Field Corrections	
5-11-41	Guardrail added	
2-25-42	Section revised	
1-14-43	Sections added and revised	
1-14-43	DESCRIPTION	
U.S. ARMY ENGINEER DIVISION NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.		
NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS		
LOCAL PROTECTION PROJECT CHANNEL SECTIONS AND DETAILS		
EAST BRANCH NEPONSET RIVER		
DATE	1 MAR 1942	MASS
SCALE AS SHOWN. NUMBER 10-214-40-31		
DRAWING NUMBER		
NEP-1-1006		



NOTES

1. These hydrographs are the mean daily discharge of the U.S.G.S gage at the East Branch of Neponset River at Canton, Mass. DA-267 Sq.Mi.
2. The data contained herein are not intended as representations or warranties but are furnished for information only. It is expressly understood that the government will not be responsible for any deductions, interpretations or conclusions therefrom made by any bidder or contractor.
3. Instantaneous peak discharges where available are shown by Q.



Record Drawing
Contract No. DA-19-013 ON ENG-2-330

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
BOSTON, MASS.

DESIGNED BY: *[Signature]* CHECKED BY: *[Signature]* DATE: MAR 1962
SUBMITTED BY: *[Signature]* APPROVED BY: *[Signature]* DATE: MAR 1962
REVIEWED BY: *[Signature]* APPROVED BY: *[Signature]* DATE: MAR 1962
SCALE: AS SHOWN SPEC NO. ENR-19-013-62-39
DRAWING NUMBER: NEP-1-1007
SHEET 7